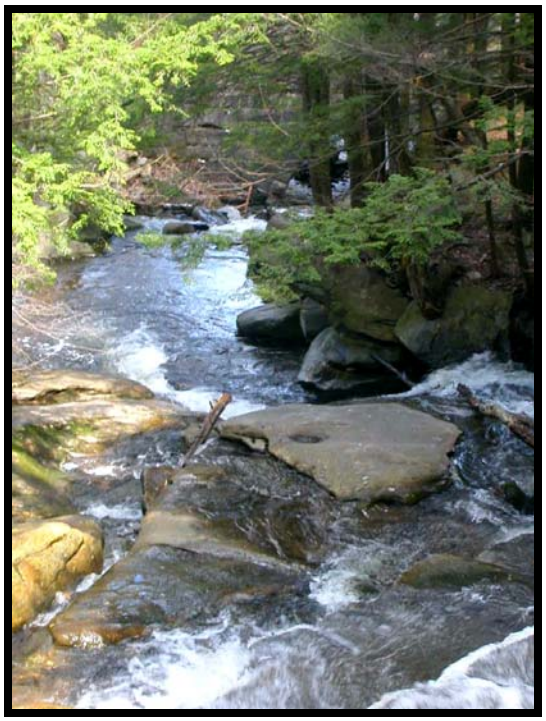
MILLERS RIVER
5-YEAR WATERSHED ACTION PLAN
2004 - 2009



MILLERS RIVER
5-YEAR WATERSHED ACTION PLAN

2005 - 2009

Prepared by:
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with technical assistance provided by:

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The Massachusetts Executive Office of Environmental Affairs

September 2004

The Commonwealth of Massachusetts

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November 22, 2004

Dear Friends of the Millers River Watershed:

It is with great pleasure that I present you with the 5-Year Watershed Action Plan for the Millers River Watershed. The plan will be used to guide local and state environmental efforts within the Millers River Watershed over the next five years. The plan expresses some of the overall goals of the Executive Office of Environmental Affairs, such as improving water quality, restoring natural flows to rivers, protecting and restoring biodiversity and habitats, improving public access and balanced resource use, improving local capacity, and promoting a shared responsibility for watershed protection and management.

The Millers River Watershed Action Plan was developed with input from the Millers River Watershed Team and multiple stakeholders including watershed groups, state and federal agencies, municipal officials, Regional Planning Agencies and, of course, the general public from across the Watershed. We appreciate the opportunity to engage such a wide group of expertise and experience as it allows the state to focus on the issues and challenges that might otherwise not be easily characterized. From your input we have identified the following priorities:

- Support Environmentally Sustainable Growth in the Watershed
- Restore and Improve Natural Flow Regimes and Aquatic Habitat
- Protect and Improve Water Quality in the Watershed
- Preserve and Restore Biodiversity and Wildlife Habitat
- Expand Public Outreach and Educational Activities in the Watershed
- Strengthen Grassroots Support for the Watershed
- Promote, Protect and Enhance the Open Space and Recreational Value of the Millers River Watershed

I commend everyone involved in this endeavor. Thank you for your dedication and expertise. If you are not currently a participant, I strongly encourage you to become active in the Millers River Watershed restoration and protection efforts.

Regards,

Ellen Roy Herzfelder

Ellen Roy Herzfelder

MILLERS RIVER WATERSHED ADVISORY COMMITTEE

Many members of the Committee were appointed to serve as representatives of their towns and currently serve on other town boards, committees, or commissions in their communities. Other Advisory Committee members are also active in local non-profit environmental organizations. Apologies for any errors or omissions with respect to members' other affiliations.

Earle Baldwin, Town of Athol
Richard Ballou, Town of Orange
Carrie Banks, MA DFG, Riverways Program
Jassy Bratko, Town of Hubbardston
Sue Cloutier, Millers River Environmental Center
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Dave Small, Athol Bird and Nature Club
Charles Thompson Smith, Town of Wendell
Karen Tucker, Town of Templeton
Douglas Turner, Town of New Salem
John H. White, Town of Winchendon
Mary Williamson, Town of Warwick
Leigh Youngblood, Mount Grace Land Conservation Trust

The Advisory Committee would like to thank the many watershed residents who attended the meetings of the Millers River Watershed Advisory Committee and the Public Forums. Also, a special thank you to Nina Keller, Jeff Mangum, Jane and Ed Galat, Warren Kimball, and Karen Tucker for the photographs used in this report and the PowerPoint presentations that were shown at the Public Forums.

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1 - INTRODUCTION

Background

The Franklin Regional Council of Governments and the Millers River Watershed Advisory Committee developed the Millers River Five-Year Watershed Action Plan (WAP) to serve as the strategic plan for implementing a broad spectrum of measures to address the priority issues in the watershed. The WAP will inform the work of the Millers River Watershed Team (Millers Team) and other stakeholders for the calendar years 2005 through 2009. The WAP is also intended to assist regulatory and funding agencies in executing their duties, including prioritizing which projects receive state and federal funds to solve the most important environmental problems in the watershed.

The WAP is the product of an extensive and inclusive planning process that incorporated the input of the Millers River Watershed Advisory Committee, the Millers Team, and other stakeholders throughout the watershed. Watershed stakeholders are a diverse group of individuals and organizations whose interests in watershed planning and other activities are reflective of their individual and collective interests. Although each member of the Advisory Committee came to the process with their own concerns and priorities, consistently open dialogue and collaborative brainstorming efforts yielded concrete measures that, when implemented, will result in measurable improvements to the watershed's resources.

The 5-Year Watershed Action Plan describes the numerous priority actions for stakeholders to implement over the next five years and the recommended lead parties for each action, as well as proposed timeframes for reaching the five-year goals. The Priority Actions in this plan are reflective of the seven overarching goals stakeholders have for the Millers River Watershed. These goals are to:

- Restore and Improve Natural Flow Regimes and Aquatic Habitat
- Preserve and Restore Biodiversity and Wildlife Habitat
- Support Environmentally Sustainable Growth in the Watershed
- Promote, Protect and Enhance the Open Space and Recreational Value of the Watershed
- Expand Public Outreach and Educational Activities in the Watershed
- Protect and Improve Water Quality in the Watershed
- Strengthen Grassroots Support for the Watershed

Planning Process

The planning process for this project began with the development of the Millers River Watershed Advisory Committee. Invitation letters were sent to the Select Boards of all the

towns in the watershed, requesting that a member be appointed to the Committee. Existing mailing lists for the Regional Open Space and Recreation Plan project and previous projects undertaken in the watershed were also reviewed and invitation letters were sent to key people from these planning projects. The Watershed Action Plan project was also advertised in several local papers and people were invited to join the project. The role of the advisory committee, which met on five separate occasions, was to provide overall direction and vision for this effort. The Franklin Regional Council of Governments compiled a summary of the existing data on water quantity and quality, fisheries and wildlife, and open space and recreation for the watershed to inform subsequent brainstorming exercises conducted with the Advisory Committee and to identify the watershed's priority issues.

Two Public Forums were held with interested stakeholders to further refine the priorities and issues identified by the Advisory Committee and to discuss new priority issues and concerns. In addition, staff from the Millers River Environmental Center conducted a focused telephone survey of town officials and conservation commission members from towns that did not have a representative on the Advisory Committee.

The culmination of these multiple and targeted outreach efforts is presented in the Key Findings section of this WAP. A corresponding list of objectives and action items are presented in Section 4. The 5-Year Action Plan identifies potential organizations to implement the action items and potential sources of funding for the proposed watershed projects are listed in Appendix A.

General Description of the Watershed[1]

The Millers River Watershed is located in the northern part of central Massachusetts and includes all or portions of seventeen (17) towns in the state. Approximately 20 percent of the watershed extends into southwestern New Hampshire, where the headwaters of the North Branch Millers River originate in the towns of Rindge and New Ipswich.

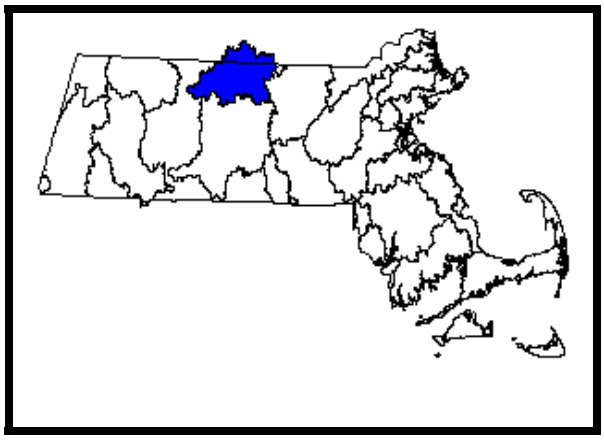


Figure 1-1 - Location of the Millers River Watershed

In Massachusetts, the Millers River begins at the outlet of Sunset Lake in Ashburnham. The North Branch Millers River and the mainstem join at Whitney Pond in Winchendon Center. From the outlet of Whitney Pond, the Millers

[1] Information for this section was compiled from the following document: Kennedy, Laurie E. and Alice M. Rojko, "Millers River Watershed 2000 Water Quality Assessment Report," Report No. 35-AC-1, MA DEP, Division of Watershed Management, Control No. CN089.0, March 2004.

River flows in a westerly direction until it empties into the Connecticut River in Montague, Massachusetts. The total river length is 51 miles, with 44 of those miles traversing Massachusetts. The total drainage area of the Millers River Watershed is approximately 398 square miles (mi^2), most of which lies in Massachusetts (310 mi^2).

The two major tributaries of the Millers are the Otter River and the Tully River. The headwaters of the Otter River originate in the large wetland areas found in the towns of Hubbardston, Templeton and Gardner. The Otter River flows in a north/northwesterly direction into the wetlands of the Otter River State Forest and then empties into the Millers River south of Lake Dennison in the town of Winchendon. The drainage area of the Otter River is 60.4 mi^2. The headwaters of the Tully River originate in Richmond, New Hampshire and Warwick, Massachusetts. The East Branch of the Tully River flows from Richmond, New Hampshire into Massachusetts and south through the town of Royalston into the Tully Reservoir. The Tully Dam and reservoir were created by the U.S. Army Corps of Engineers as a flood control project. After leaving the reservoir, the East Branch of the Tully River flows south to Athol where it joins the West Branch of the Tully River. The West Branch flows from the outlet of Sheomet Lake in a southeasterly direction through Orange into Athol where it joins the East Branch and becomes the Tully River. The Tully River flows in a southerly direction and empties into the Millers River just north of Route 2A in Athol. The drainage area of the Tully River is 74.0 mi^2.

As the following photographs indicate, the watershed includes some of the most scenic landscapes in the state[2]. The rugged and steep upland areas in the watershed range in altitude from 200 to 1,500 feet. There are approximately 4,121 acres of ponds, lakes and reservoirs in the watershed. Most of the land in the watershed is forested (81%) and the land use is characterized as open space or farmland (6%), wetlands (6%), and urban land (7%).[3] Approximately 92,000 people live in the watershed and the population centers include the Gardner, Athol and Orange areas.[4] Many rivers and lakes in the watershed are used for recreation, including swimming, boating, fishing and sightseeing.

[2] Photograph on this page courtesy of the Massachusetts Executive Office of Environmental Affairs (EOEA) website: www.state.ma.us/envir/water/millers/millers.htm.
[3] www.state.ma.us/envir/water/millers/millers.htm.
[4] Ibid.

Designated public access points, for recreational activities such as boating, fishing, or swimming, are located at Lake Rohunta in Orange, the Millers River in Orange, Lake Dennison in Winchendon, Tully Lake in Royalston, and Laurel Lake in Erving.[5] The watershed's vast acreage of open space and forested lands in public and quasi-public ownership also support a wide variety of other outdoor recreational opportunities including camping, picnicking, hiking, cross-country skiing, bird watching, and scenic viewing.[6,7]

[5] Kennedy and Rojko, op.cit.
[6] www.state.ma.us/envir/water/millers/millers.htm.
[7] Upper left photograph on this page courtesy of the Massachusetts Executive Office of Environmental Affairs (EOEA) website: www.state.ma.us/envir/water/millers/millers.htm; lower right photograph on this page courtesy of Nina Keller, Wendell resident.

Subwatersheds[8]

The Massachusetts Department of Fish and Game (formerly the Department of Fisheries, Wildlife and Environmental Law Enforcement) has delineated fourteen (14) major subwatersheds within the Millers River Watershed as shown in Figure 1-2. Brief descriptions of the subwatersheds are provided in the following sections.

1 - Lower Millers Subwatershed

In this subwatershed, the Millers River flows westward through steep, hilly terrain, forming the boundary between the towns of Erving and Wendell, and then the boundary between Erving and Montague, passing through the Village of Millers Falls, where it empties into the Connecticut River. Numerous small tributaries drain into the Millers in this subwatershed. The drainage area is approximately 34.8 mi^2.

2 - Whetstone Brook Subwatershed

The drainage area of this subwatershed is approximately 5.2 mi^2. The headwaters of Whetstone Brook originate northeast of Orcutt Hill, near New Salem Road in Wendell and then flow in a northerly direction to join the Millers River in Wendell.

3 - Lake Rohunta Subwatershed

A series of interconnected brooks, wetlands and ponds in Petersham and South Athol contribute water to Lake Rohunta which in turn empties into the Millers River in Orange. The total drainage area for this subwatershed is 20.2 mi^2.

4 - Middle Millers River Subwatershed

This subwatershed includes Whitney Pond in Winchendon, into which flows the North Branch Millers River. The outlet of Whitney Pond joins the mainstem of the Millers River in Winchendon. The Millers River flows west and then south through Winchendon, where the Otter River empties into it. The Millers flows through Birch Hill Dam in South Royalston and on into Athol, through hilly, steep terrain before it enters a wetland area at its confluence with the Tully River. The river continues its westward course, flowing through the Town of Orange collecting flow from West Brook, Moss Brook and Whetstone Brook. The boundaries of this subwatershed end at the Erving Town Line. The drainage area for this subwatershed is 62.3 mi^2.

[8] Information for the subwatersheds was compiled from Kennedy and Rojko, op.cit., and the "Assessment of Potential Non-Point Pollution for the Millers River Watershed in Massachusetts" prepared by the Montachusett Regional Planning Commission and the Franklin Regional Council of Governments, July 2002.

5 - Otter River Subwatershed

The Otter River is one of two major tributaries to the Millers River. The drainage area for the Otter River is approximately 60.4 mi^2. The Otter River originates in Hubbardston, just north of Pitcherville Road and meanders north through wetlands into Templeton. Templeton Brook, Hubbardston Brook and Pond Brook all empty into the Otter as it continues to flow north, forming the boundary between the towns of Gardner and Templeton. The Otter River flows north through Templeton and the Village of Baldwinville into the extensive wetlands of the Otter River State Forest before it empties into the Millers River.

6 - Upper Millers River Subwatershed

This subwatershed is located in the towns of Ashburnham and Winchendon and includes several large lakes, streams and wetland areas that drain into Sunset Lake. The Millers River begins at the outlet of Sunset Lake. The river then flows in a southwesterly direction into Whitney Pond in Winchendon. The drainage area for this subwatershed is approximately 27.2 mi^2.

7 - North Branch Millers River Subwatershed

The total drainage area for this subwatershed is 20.0 mi^2, most of which is located in New Hampshire. Approximately 4.5 mi^2 of the subwatershed is located in Massachusetts and land use in this portion is 75% forest, 10% residential and 3% open land. In Massachusetts, the North Branch Millers River begins at the outlet of Lake Monomonac in Winchendon and then the river flows into Whitney Pond in Winchendon. Water flows from Whitney Pond into the mainstem of the Millers River.

8 - Tarbell Brook Subwatershed

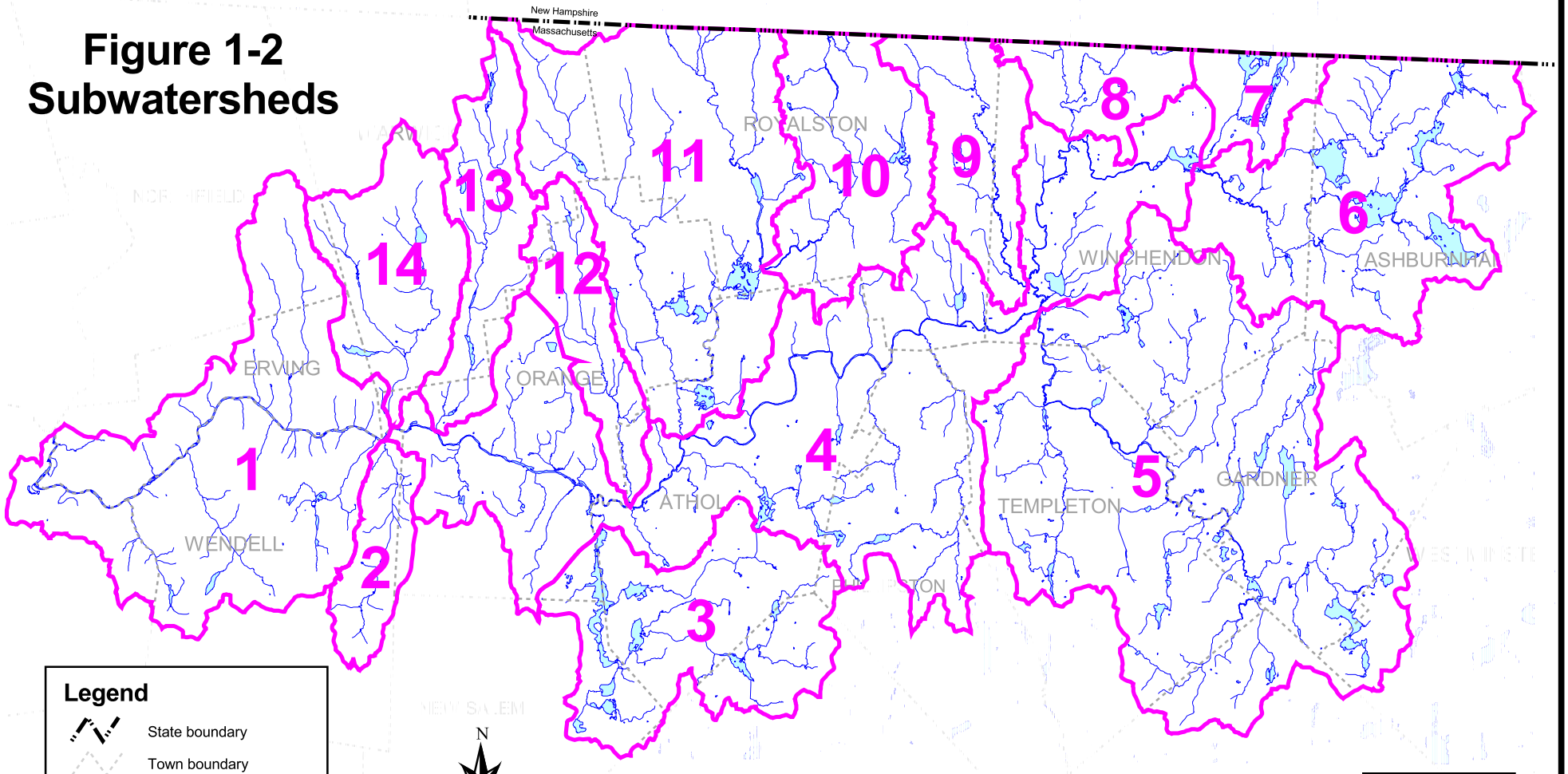
The headwaters of Tarbell Brook are in Rindge and Jaffrey, New Hampshire. Once the brook crosses into Winchendon, Massachusetts, it collects flow from Spud Brook and then joins the Millers River. The drainage area for the Massachusetts portion of the subwatershed is approximately 6 mi^2.

9 - Priest Brook Subwatershed

Priest Brook is formed at the confluence of Scott and Towne Brooks whose headwaters are located in Fitzwilliam, New Hampshire. Priest Brook flows in a southeasterly direction through Royalston and enters the Millers River in Winchendon, just west of Lake Dennison. Most of the Massachusetts portion of this subwatershed is located within the Birch Hill State Wildlife Management Area. The total drainage area for this subwatershed is approximately 24.0 mi^2 of which 9.8 mi^2 are located in Massachusetts.

Millers River 5-Year Watershed Action Plan

Figure 1-2
Subwatersheds

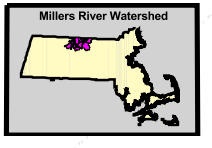


Legend

- State boundary
- Town boundary
- River, stream
- Sub-watershed boundary

N W E S

0 2 4 6 8 Miles



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Map Sources:

Map produced by The Franklin Regional Council of Governments Planning Department. GIS data sources include the FRCOG Planning Department, the Massachusetts Highway Department, MassGIS, Massachusetts Natural Heritage and Endangered Species Program, and United States Fish and Wildlife Service. Digital data obtained from MassGIS represent the efforts of the Massachusetts Executive Office of Environmental Affairs and its agencies to record information from the sources cited in the associated documentation. EOEA maintains an ongoing program to record and correct errors in the GIS data that are brought to its attention. EOEA makes no claims as to the reliability of the GIS data or as to the implied validity of any uses of the GIS data. EOEA maintains records regarding all methods used to collect and process these digital data and will provide this information on request. Executive Office of Environmental Affairs, MassGIS EOEA Data Center, 251 Causeway Street, Suite 900, Boston, MA, 617-626-1000.

Sub-watershed boundary, town boundary, river, and stream data provided by MassGIS.

Note: Depicted boundaries are approximate and are intended for planning purposes only. Portions of the source data were obtained from 1:100,000 scale maps, therefore the accuracy of the line work on this map is +/-100 feet.

Sub-basin	Number	Sub-basin	Number
Lower Millers	1	Tarbell Brook	8
Whetstone Brook	2	Priest Brook	9
Lake Rohunta	3	Lawrence Brook	10
Middle Millers River	4	Tully River	11
Otter River	5	West Brook	12
Upper Millers River	6	Gales Brook	13
North Branch Millers	7	Moss Brook	14

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September 2004

10 - Lawrence Brook Subwatershed

Lawrence Brook originates at the outlet of Sportsman Pond in Fitzwilliam, New Hampshire and meanders into a large wetland in Royalston, Massachusetts. As it flows south, several small tributaries empty into Lawrence Brook. The brook continues in a southerly direction and flows through another large wetland just to the east of Doane's Falls. Here, the brook drops almost 150 feet, creating a spectacular water fall, before it enters Tully Lake. The drainage area of this subwatershed is approximately 26.2 mi^2 of which 14.6 mi^2 are located in Massachusetts.

11 - Tully River Subwatershed

The Tully River is formed by the confluence of the East Branch Tully River and the West Branch Tully River. The East Branch Tully River is formed by the confluence of Falls Brook and Tully Brook in the Royalston State Forest. The East Branch flows south, collecting flow from Boyce Brook to the east, and then empties into Long Pond. Long Pond flows into Tully Lake, an Army Corps of Engineers flood control project. Downstream of Tully Dam, the East Branch flows south and then west, forming the boundary between the towns of Orange and Athol. The East Branch joins the West Branch in Athol.

The outlet of Sheomet Lake in Warwick forms the West Branch Tully River. The West Branch then flows southeastward into Tully Meadow where it is joined by Collar Brook, and then in a southerly direction into a wetland area to the west of Tully Mountain. The drainage area is approximately 34 mi^2 for this subwatershed.

12 - West Brook Subwatershed

West Brook flows south through the Town of Orange before it empties into the Millers River west of the Athol central business district. This subwatershed is small, with a total drainage area of 7.7 mi^2.

13 - Gales Brook Subwatershed

This tributary of the Millers flows in a southerly direction through the eastern part of the Town of Warwick before it joins the Millers River. The total drainage area for this subwatershed is 10.1 mi^2.

14 - Moss Brook Subwatershed

Moss Brook flows through the western portion of Warwick south into Orange where it joins the Millers River at the border of Orange, Wendell and Erving. The total area in the subwatershed is 12.2 mi^2.

Watershed Geology and Topography

The surficial and bedrock geology of the Millers River watershed are the result of thousands of years of volcanic activity, shifting faults, erosion and climatic changes. The underlying igneous and metamorphic bedrock is often at or near the surface and shows evidence of repeated glaciations. The surficial geology of the watershed is dominated by glacial till, which consists of unsorted clay, silt, sand and gravel. The glacial till in the Millers River Watershed is typically acidic. As a result, the lack of buffering capacity of these sediments leaves the aquatic life of the Millers River and its tributaries vulnerable to the effects of acid rain.

In the lowland areas, river valleys, and along the banks of brooks and streams, large quantities of glacial outwash and alluvial sediments (typically well sorted, unconsolidated sand, gravel, silt and clay) cover the bedrock and till. Most of the watershed soils in the lowland areas are deep, loamy, sandy soils which formed in the glacial till and outwash, lacustrine and alluvial sediments.

The steep, hilly terrain and the valley lowland areas that dominate the scenic landscape of the watershed today are the result of past glacial activity and years of weathering and erosion. The glacier carved deep grooves in the land and polished more resistant bedrock areas into "monadnocks" which remain today as the numerous small hills and mountains that dot the landscape. Mt. Monadnock in New Hampshire and Mt. Wachusett in Westminster, Massachusetts, both visible from many places in the Millers River Watershed, are spectacular examples of the sculpting ability of glaciers. The gently rolling topography in the eastern portion of the watershed, dotted with numerous small hills, large wetland areas and ponds, contrasts sharply with the rugged, hilly terrain and deep, incised river valleys characteristic of the towns of Royalston, Warwick, Erving, Athol and Wendell.

Overall, the Millers River has a moderate gradient, dropping an average of 18 feet in elevation per mile from its headwaters in Ashburnham to Erving, a distance of approximately 43 river miles.[9] This translates into a relative change in elevation of approximately 774 feet between Ashburnham and Erving. However, over a 5 mile reach of the river as it travels from South Royalston to Athol (an area known as "The Chute" and includes the area known as "Bears Den"), the average drop in elevation is much more dramatic, approximately 43 feet each mile, which is about five times the average gradient for rivers in Massachusetts.[10] The Chute and another section of rapids on the mainstem (a 10.5 mile reach of river that begins in Orange, goes through Erving, and ends in Millers Falls) attract many whitewater enthusiasts to the area. Another spectacular change in gradient is exhibited by the East Branch Tully River which drops an average of 52 feet per mile over a distance of 13 river miles.

[9] USGS website. www.ma.water.usgs.gov/basins/millerssfw.htm
[10] Ibid.

Precipitation[11]

Both the annual and seasonal distribution of precipitation in the Millers River Watershed influence the timing and magnitude of runoff (water that is not absorbed by soils) that flows into the Millers and its tributaries. Because of the areal size of the watershed and differences in topography, meteorological conditions can vary. For example, a summer thunderstorm in the eastern portion of the watershed may not affect the western portion of the watershed. Also, areas of higher elevation may receive more precipitation than areas of lower elevation. Despite local differences in precipitation amounts, the average annual precipitation throughout the watershed remains stable and is approximately 42-43 inches per year.[12] Table 1-1 includes data collected from five long-term and one short-term precipitation gages in the watershed.

Table 1-1
Millers River Watershed Precipitation Gages and Period of Record[13]

Statistic	Winchendon 1894-2001	Tully Lake 1984-2001	Athol 1912-2001	Templeton 1907-2001	Gardner 1906-2001	Fitzwilliam 1920-2001
Ave. Annual Precipitation	43.03 inches/year	45.03 inches/year	42.75 inches/year	42.28 inches/year	43.38 inches/year	44.26 inches/year
Max. Annual Precipitation	59.95 inches in 1938	58.66 inches in 1996	61.94 inches in 1972	65.90 inches in 1996	61.01 inches in 1938	56.92 inches in 1975
Ave. Monthly Minimum Precipitation	2.94 inches in Feb	2.52 inches in Feb	2.79 inches in Feb	2.84 inches in Feb	3.12 inches in Feb	2.85 inches in Feb
Ave. Monthly Maximum Precipitation	3.93 inches in July	4.70 inches in Aug	4.03 inches in July	3.96 inches in July	3.99 inches in Nov	4.07 inches in July
Maximum Monthly Precipitation	15.89 inches in Sep 1938	10.15 inches in Oct 1995	15.86 inches in Sep 1938	13.44 inches in June 1922	17.31 inches in Sep 1938	14.21 inches in June 1922
Minimum Monthly Precipitation	0.03 inches in Oct 1924	0.21 inches in Feb 1987	0.04 inches in Oct 1924	0.02 inches in Oct 1924	0.01 inches in Mar 1915	0.00 inches in Oct 1924

Note: Frozen precipitation is melted and reported as inches of water.

[11] Gomez & Sullivan, "Hydrologic Assessment of the Millers River: Final Report," April 2003.
[12] Ibid.
[13] Table adapted from Gomez & Sullivan, op.cit.

2 - ENVIRONMENTAL ASSESSMENT

Current Environmental Conditions

This chapter includes information on the environmental conditions of the Millers River Watershed with respect to water quantity, water quality, wildlife habitat, land use, open space and recreation, and public outreach/education. Data, reports and other information generated by federal and state agencies, regional planning agencies, municipalities and non-profit groups were used to compile this chapter. A complete list of sources used or reviewed during the preparation of this Watershed Action Plan is included in the bibliography.

The purpose of this chapter is to:

- Distill the currently available environmental information for the watershed and present a concise summary by category;
- Provide sufficient information to inform a discussion of the priority issues in the watershed; and
- Identify data gaps that could be the focus of future projects conducted in the watershed.

Water Quantity

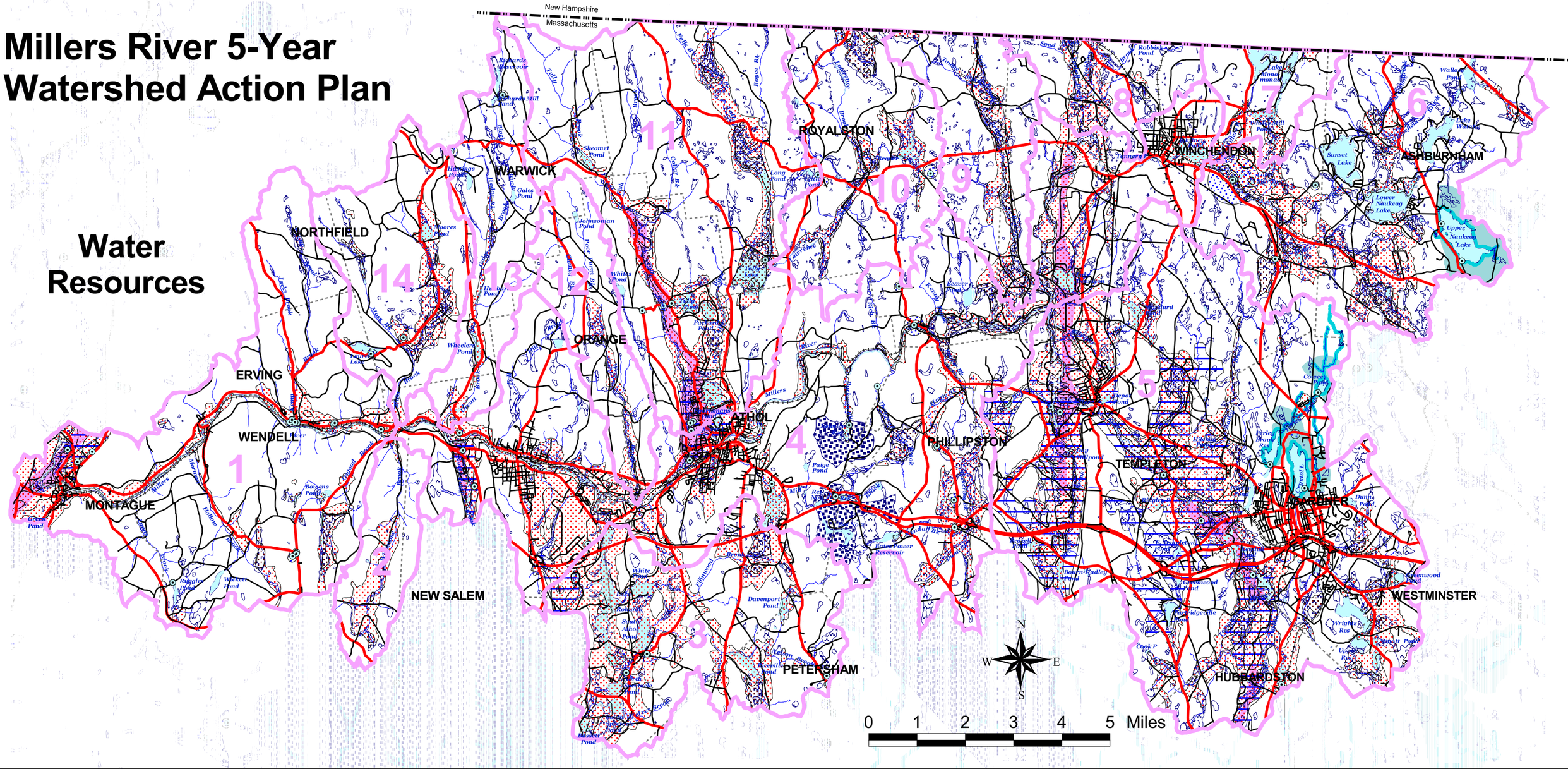
Aquifers

The large quantities of unconsolidated sand and gravel deposits left behind by the melting glaciers can store and transmit large quantities of water. The largest area of stratified glacial deposits is found in what was a glacial lake located near Orange. Meltwater streams poured off of the retreating glacier and deposited huge quantities of sediment, up to 200-feet thick, into this lake.[14] Other areas in the watershed with glacial deposits capable of yielding moderate to large quantities of groundwater occur near the mouth of the Millers River in Millers Falls, along the West Branch Tully River northwest of Athol, along the Otter River and Trout Brook, and in the Winchendon area.[15] Groundwater sufficient for domestic uses, whether from bedrock or stratified glacial deposits, is available nearly everywhere in the watershed.[16]

[14] USGS website: www.ma.water.usgs.gov/basins/millersgw.htm
[15] Ibid.
[16] Ibid.

Millers River 5-Year Watershed Action Plan

Water Resources



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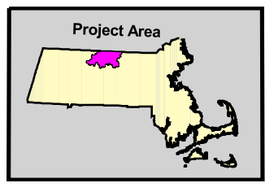

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North Branch Millers	7	Moss Brook	14

Map Sources:

Map produced by The Franklin Regional Council of Governments Planning Department. GIS data sources include the FRCOG Planning Department, the Massachusetts Highway Department, MassGIS, Massachusetts Natural Heritage and Endangered Species Program, and United States Fish and Wildlife Service. Digital data obtained from MassGIS represent the efforts of the Massachusetts Executive Office of Environmental Affairs and its agencies to record information from the sources cited in the associated documentation. EOEA maintains an ongoing program to record and correct errors in the GIS data that are brought to its attention. EOEA makes no claims as to the reliability of the GIS data or as to the implied validity of any uses of the GIS data. EOEA maintains records regarding all methods used to collect and process these digital data and will provide this information on request. Executive Office of Environmental Affairs, MassGIS EOEA Data Center, 251 Causeway Street, Suite 900, Boston, MA, 617-626-1000.

Road data provided by MassHighway. Town boundary, rail line, river, steam, pond, public water supply, aquifer, surficial geology, wellhead protection area, surface water supply protection area, and outstanding resource water data provided by MassGIS.

Note: Depicted boundaries are approximate and are intended for planning purposes only. Portions of the source data were obtained from 1:100,000 scale maps, therefore the accuracy of the line work on this map is +/-100 feet.

Legend

- State boundary
- Town boundary
- Rail line
- River, stream
- Public water supply well
- Sub-watershed boundary
- DEP Zone I water protection area
- DEP Zone II
- 1-14 Sub-basins (see table)
- Surficial geology - sand and gravel
- Surficial geology - floodplain alluvium
- National Wetland Inventory wetland
- DEP Interim Wellhead Protection Area
- Outstanding Resource Waters
- Aquifer (yield >200 gallons per minute)
- Zone A
- Zone B
- Water body

Roads

- Minor roads
- Major roads

September 2004

Water Withdrawals[17]

Six (6) of the seventeen (17) communities in the Millers River Watershed have municipal public water supplies (groundwater wells or surface water reservoirs) located within the watershed boundaries. These withdrawal points are required to be registered and/or permitted under the Massachusetts Water Management Act (WMA). The regulations for the WMA stipulate that any water withdrawal greater than the 100,000 gallons per day (0.1 million gallons per day) threshold must be registered and/or permitted. There are also four (4) registered/permitted industrial water users, although only two are currently active. Table 2-1 lists the WMA permitted withdrawals and the authorized volume of water that can be withdrawn each day.

Table 2-1

Water Management Act Registered and Permitted Water Withdrawals in the Millers River Basin[18]

Withdrawal Type	Authorized Average Daily Withdrawal in 2000 (million gallons per day-mgd)
Public Water Suppliers	
Ashburnham Water Department	0.18
Athol Department of Public Works- Water Division	1.04
Gardner Department of Public Works- Water Division	1.69
Orange Water Department	0.93
Templeton Water Department	0.84
Winchendon Water Department	0.67
TOTAL: Public Water Suppliers	**5.35 mgd**
Industrial Water Users	
American Tissue Mills of Mass., Inc.	2.02 (inactive as of 9/1995)
Erving Paper Mills	2.66
International Paper Company-Strathmore Millers Falls Facility	0.75 (inactive as of 8/2000)
Seaman Paper Co. of MA, Inc	1.19
TOTAL: Industrial Users	**6.62 mgd**
TOTAL WATERSHED: Average Daily Withdrawal	**11.97 mgd**

Both groundwater and surface water withdrawals can impact river flows between the point of withdrawal and the return flow location (typically a wastewater treatment plant). Large withdrawals, such as those for a municipal water supply, will reduce the volume of flow downstream of the withdrawal point. This reduction in flow can adversely impact the aquatic resources downstream. During the summer, when river flows are typically low, the magnitude

[17] Information for this section was obtained from Gomez & Sullivan, op.cit.
[18] Table adapted from Gomez & Sullivan, op.cit.

of the water withdrawal relative to the magnitude of river flow becomes especially critical.[19] Typically, the volume of water withdrawn increases during the summer to meet peak demand. Larger withdrawal volumes have the potential to reduce the amount of available aquatic habitat and impair water quality (low levels of dissolved oxygen and increased water temperature).[20]

Water Budget and Water Conservation

In terms of a water budget for the watershed (inflow versus outflow), most of the water withdrawn from the aquifers and surface waters of the Millers River Watershed is returned to the watershed via wastewater treatment facilities or septic systems. The one exception is the Ashburnham Water Department which sends a small portion of their withdrawal out of the Millers River Watershed into the Nashua River Watershed. The Town of Ashburnham straddles the watershed divide between the Millers and Nashua Rivers. Therefore, there is only a minor loss of water from the basin.

The state has two criteria which are used to evaluate the water conservation efforts of municipal public water supplies: 1) is residential water use less than 70-80 gallons per capita per day (gpcd)?; and, 2) is unaccounted for water (UAW) less than 10%-15% of the total water supply?[21] According to the data evaluated by Gomez & Sullivan, five (5) out of the six (6) public water suppliers in the Millers River Watershed exceeded the 10% UAW metric at some point in the last three years. In most cases, water suppliers explained that the high UAW was due to leaks, fire flow, etc. All water suppliers reported residential water usage below the 80 gpcd metric.

Current and Future Water Demand

Gomez & Sullivan estimated future water demands in the basin for each public water supplier. Data on withdrawal rates from the previous three years and forecasted population growth data were used in this analysis. As expected, water demand in the watershed is expected to increase, although the rate of growth appears manageable with respect to the availability of drinking water. To meet the projected future water demand, municipalities may have to consider a range of strategies such as: implementing aggressive water conservation measures; increasing withdrawals at existing locations; adding new withdrawals; and importing water from other basins. However the impacts of these potential withdrawal options have not been assessed at this point and would require further environmental evaluation. Table 2-2 lists the current average daily demand for the watershed as a whole, the forecasted demand, and the percent change through the year 2020. Of particular note is the current average daily demand of 5.28 million gallons per day (mgd) is less than the authorized withdrawal volume for the watershed as a whole (5.35 mgd). However, as Table 2-2 indicates, the authorized withdrawal volume for the watershed could be exceeded by 2005.

[19] Gomez & Sullivan, op.cit.
[20] Gomez & Sullivan, op.cit.
[21] Gomez & Sullivan, op.cit.

Table 2-2

Projected Future Water Supply Demand in the Millers River Watershed[22]

Year	Current	2005	2010	2020
Demand (mgd)	5.28 mgd	5.75 mgd	5.91 mgd	6.25 mgd
Net Difference Relative to Current Demand	n/a	0.47 mgd	0.63 mgd	0.97 mgd
%Increase Relative to Current Demand	n/a	8.8%	11.9%	18.4%

Note: mgd = million gallons per day; n/a = not applicable

Stressed Watersheds

An interagency committee convened by the Massachusetts Water Resources Commission (WRC) issued a report on December 13, 2001 which described a methodology to define a stressed river basin (watershed). According to the report, the stressed basin classification is intended to be used by regulators, municipalities, and project proponents to identify areas which may require more comprehensive review of environmental impacts or additional mitigation measures.[23] This information can also be used by communities to help direct proposed development to more suitable areas.

The study identified three factors that contribute to the health of a watershed, including: streamflow quantity, streamflow quality and habitat. Since streamflow data is readily available (data from 72 USGS stream gages were evaluated) and computerized (unlike data for water quality and habitat), the study focused on determining basin stress levels for streamflow quantity (hydrologic stress) only. However, it can be inferred that if a watershed is experiencing hydrologic stress, it is likely that water quality and habitat areas will also be exhibiting signs of stress. Adequate streamflow is a basic requirement to maintain streamflow quality and the availability and quality of habitat. The stress levels reported for the Millers River Watershed and several tributaries are shown in Table 2-3. The hydrologic stress classifications for the Millers River Watershed are defined as the relative strength of the watershed's rivers in relation to other rivers in Massachusetts.

[22] Table adapted from Gomez & Sullivan, op.cit.

[23] Massachusetts Water Resources Commission, "Stressed Basins in Massachusetts," December 13, 2001. www.state.ma.us/DCR/programs/intbasin/stressed_basins.htm

Table 2-3

Stress Levels for River Segments[24]

USGS Station Number	Gage Name	Final Stress Level
01165000	East Branch Tully River near Athol	HIGH
01162500	Priest Brook near Winchendon	HIGH
01166500	Millers River at Erving	MEDIUM
01164000	Millers River at South Royalston	MEDIUM
01162000	Millers River near Winchendon	MEDIUM
01161500	Tarbell Brook near Winchendon	MEDIUM
01163200	Otter River at Otter River	MEDIUM*

**Data for the Otter River indicates a low stress classification but it is classified at medium stress due to a medium stress classification downgradient.*

In addition to the WRC stress classification, Gomez & Sullivan performed a simple water budget analysis to evaluate the stress level for several subwatersheds that have large water withdrawals (public water supplies) and large wastewater discharges (sewage treatment plants) . Using one of the methodologies outlined in the WRC report to determine a subwatershed's stress level (low, medium, or high), Gomez & Sullivan assessed the Otter River, Upper Naukeag Lake, Tully River, and North Pond Brook subwatersheds as well as the entire Millers River Watershed.

As previously noted for the WRC stress evaluation, the Gomez & Sullivan analysis only examined hydrologic stress and did not consider many other factors that play a role in river stress such as dam operations, water quality or instream habitat. As an example, the stress level in a particular river reach may be considered low using the classification system, however, dam operations may result in pulsing flows, or water quality is considered poor. These factors would likely change the stress level to medium or high.

Table 2-4 lists the subwatersheds and the water withdrawal points and return flows within each subwatershed. Of note is the fact that the smaller subwatersheds do not receive return flow

[24] Table adapted from Gomez & Sullivan, op.cit.

from wastewater treatment plants because these facilities discharge to the Otter River or Millers River. This methodology might also underestimate the impact of water withdrawals, particularly in larger watersheds. For example, the Tully River subwatershed contains three wells operated by the Athol Water Division that withdraw water just upstream of the confluence with the Millers River. The drainage area for the Tully River at the confluence with the Millers River is 74.0 mi^2 and thus the magnitude of withdrawal relative to the drainage area is small. Therefore, the stress level is low. However, site specific conditions may change the stress level.

Table 2-4

Subwatershed Data Used to Estimate Stress Level[25]

Subbasin Name	Water Withdrawer	Wastewater Discharge
Otter River	Gardner Dept Pub Works	Gardner WWTP
	Templeton Water Dept.	Town of Templeton
	Seaman Paper	Seaman Paper Co.
	American Tissue	
Upper Naukeag Lake	Ashburnham Water Dept.	
	Winchendon Water Dept.	
Tully River	Athol Dept of Pub Works	
North Pond Brook	Orange Water Dept (Wells 1 and 2)	
Unnamed Tributary to Millers River	Orange Water Dept (Well 3)	
Millers River (includes all withdrawals greater than 0.1 MGD and all NPDES discharges)	Gardner Dept Pub Works	Gardner WWTP
	Templeton Water Dept.	Town of Templeton
	Seaman Paper	Seaman Paper Co.
	American Tissue Ashburnham Water Dept.	Town of Orange Winchendon WPCF
	Winchendon Water Dept.	Templeton Developmental Center
	Athol Dept of Public Works	Athol WWTP
	Orange Water Dept	L.S. Starrett Co.
	Erving Paper	Town of Royalston
	International Paper	Erving Center WWTP
		Town of Erving, POTW #1

[25] Table adapted from Gomez & Sullivan, op.cit.

Table 2-5

Stress Level Summary for Selected Subwatersheds[26]

Subwatershed	Drainage Area (square miles)	WRC-Method Stress Classification
Otter River	60.54	MEDIUM
Upper Naukeag Lake	1.90	HIGH
Tully River	74.0	LOW
North Pond Brook	1.98	MEDIUM
Millers River	388.87	LOW

Dams

Like most large rivers in Massachusetts, many dams were built within the Millers River Watershed both on the mainstem and its tributaries. These dams were constructed for industrial uses, and to provide hydroelectric power, water supply, fire protection, flood storage and recreation. In the Massachusetts portion of the watershed, there are approximately 197 dams, many of which were constructed years ago to provide water and power for the region's industrial growth and have since been abandoned.[27] There are eight (8) dams on the mainstem of the Millers and five (5) of these dams have hydropower turbines to produce electricity.[28] Many other dams are located along the two major tributaries to the Millers, the Tully and Otter Rivers, as well as the smaller tributaries. The U.S. Army Corps of Engineers operates two flood control projects in the watershed, namely – Birch Hill Dam and Tully Dam, which are discussed in more detail, below.

The Hydrologic Assessment prepared by Gomez & Sullivan evaluated the operations of fifteen (15) dams considered to have the ability to significantly regulate the flow of the river as well as those considered to be high hazard dams (those dams that, if they were to fail, would cause significant loss of life and extensive property damage). When assessing the environmental conditions in a watershed, it is important to understand the impact that dam operation and function has on the flow regime of the river and its aquatic resources. For example, the Corps flood control projects affect the timing and magnitude of spring flows that would otherwise occur naturally downstream of these projects. The operation of other dams for recreation, hydroelectricity generation and water supply also impact the timing and magnitude of flows. Of particular note is that most of the dams in the watershed, except the ones that are exempt from federal regulation, do not have operating requirements such as

[26] Table adapted from Gomez & Sullivan, op.cit.
[27] Gomez & Sullivan, op.cit.
[28] Gomez & Sullivan, op.cit.

minimum flows.[29] In most cases, the smaller dams are operated as run-of-river facilities, where inflow equals outflow, except during periods when flashboards are removed in the fall and then replaced after the spring runoff.[30]

Hydroelectric Facilities[31]

There are no hydroelectric power plants in the Massachusetts portion of the Millers River Watershed that are licensed by the Federal Energy Regulatory Commission (FERC). There are six (6) power-generating projects on the river that are exempt from the FERC regulations. FERC grants exemptions for small hydroelectric projects that have a generating capacity of less than 5 megawatts and meet certain other requirements. Although the exemptions are granted in perpetuity, Article 2 of the exemptions states that the projects must comply with any terms and conditions that any Federal or state fish and wildlife agency imposes to prevent the loss of or damage to fish or wildlife resources. The six developments (upstream to downstream order) on the Millers River are briefly described in Table 2-6.

Additionally there is one FERC non-jurisdictional hydropower project on the Millers River at the Crescent Street Dam. Like many of the dams in the watershed, no regulations govern operations other than the owner must report to the Massachusetts Office of Dam Safety. The Crescent Street Dam, located just downstream of the Cresticon Lower Development, is owned by the L.S. Starrett Company in Athol. There are two hydropower facilities associated with this dam, one on the north and one on the south side of the dam, with nameplate capacities of 250 and 112 kilowatts, respectively, for a total of 362 kilowatts.

Flood Control Projects

Tully Lake Dam and Birch Hill Dam are Army Corps of Engineers' (USACE) flood control projects in the Massachusetts portion of the Millers River Watershed and are part of a larger network of flood control dams on tributaries of the Connecticut River. These dams are exempt from FERC licensing; therefore, there is no operational oversight other than that provided by the USACE. Recently, the Army Corps of Engineers and the US Fish and Wildlife Service (USFWS) have been meeting to discuss project operations and concerns the USFWS has primarily regarding the timing and magnitude of discharges downstream of the facilities.

Tully Lake Dam and its impoundment, Tully Lake, are located on the East Branch of the Tully River in Royalston. The project was constructed between 1947 and 1949 to reduce flood stages in Athol, Orange and other communities along the Millers River.[32]

Birch Hill Dam is located on the Millers River in South Royalston. Birch Hill was completed in 1941 and has a storage capacity of 16.3 billion gallons of water.[33] This project

[29] Gomez & Sullivan, op.cit.
[30] Gomez & Sullivan, op.cit.
[31] Kennedy and Rojko, op.cit.
[32] U.S. Army Corps of Engineers, Tully Lake website. www.nae.usace.army.mil/recreati/tul/tulfc.htm
[33] U.S. Army Corps of Engineers, Birch Hill website. www.nae.usace.army.mil/recreati/bhd/bhdfc.htm

is operated as a "dry bed" reservoir to reduce flood stages at Athol, Orange and other downstream communities. During normal, non-flood control operation, no reservoir is maintained behind the dam and inflow equals outflow. During flood control operations, water is held back behind Birch Hill Dam and floods up to 3,200 acres of land.[34] Approximately 20% of the reservoir area is flooded 9 out of 10 years.[35]

Table 2-6

FERC-Exempt Hydroelectric Projects in the Millers River Watershed[36]

Project Name and (Project Number)	***Owner Name Issuance Date***	***River/Location***	***Kilowatts***
Hunts Pond (8012)	O'Connell Engineering & Financial 19 February 1985	Millers River/ Winchendon	120
Tannery Pond (8895)	O'Connell Engineering & Financial 20 April 1988	Millers River/ Winchendon	189
Cresticon Upper (10163A)	LP Athol Corp 12 February 1988	Millers River/ Athol	250
Cresticon Lower (10163B)	LP Athol Corp 12 February 1988	Millers River/ Athol	250
New Home North (6096A)	O'Connell Energy Group 28 December 1984	Millers River/ Orange	187
New Home South (6096B)	O'Connell Energy Group 28 December 1984	Millers River/ Orange	240

Water Quality

There are a number of sources of contamination which affect water quality in the watershed. Some of these sources are relatively easy to identify (pipes that discharge directly into the river) and these discharges are regulated by state and federal agencies. Examples of these "point sources" include industrial and municipal wastewater treatment plant discharges. Other sources of contamination are more diffuse and more difficult to identify and mitigate. Examples of these "nonpoint sources" include untreated road runoff, illegal dumping and road salt.

Potential Point Sources of Pollution

[34] ENSR International. "Downgradient Property Status Opinion, Birch Hill Dam Flood Control Project (DEP Site No. 2-0664)," October 2001.
[35] Ibid.
[36] Kennedy and Rojko, op.cit.

Wastewater Discharges[37]

The mainstem of the Millers River and several of its tributaries receive treated wastewater (effluent) from municipal and industrial sources. These discharges are regulated under the Federal Clean Water Act via the National Pollutant Discharge Elimination System (NPDES) permitting process which is administered by the MA DEP and the U.S. Environmental Protection Agency. There are a total of twelve (12) NPDES permits in the Millers River Watershed. In addition, the Ashburnham and Winchendon Joint Water Authority are authorized to discharge effluent from their Water Treatment Plant (for the municipal drinking water supply) to Upper Naukeag Lake.

Municipal Wastewater Treatment Plants

Municipal Wastewater Treatment Plants (WWTP) treat wastewater collected from residential, commercial and industrial sources. Typically, WWTPs follow a daily cycle which corresponds to cycles of water use (higher volumes of water are used in the morning and evening). Discharges of treated effluent to a river may follow a similar pattern, e.g., hourly flows may also cycle over a day.[38]

Six (6) WWTPs discharge effluent to the mainstem of the Millers. These facilities are located in Winchendon, Royalston, Athol, Orange, Erving-Center and Erving-Millers Falls. Two (2) WWTPs discharge effluent into the Otter River (Gardner and Templeton). Erving #3, a large septic system, discharges to a small tributary of the Millers. Discharge volumes range from a monthly permitted average flow of 0.01 million gallons per day (mgd) for Erving #3 to the City of Gardner's treatment plant which has a permitted capacity of 5.0 mgd.

As part of the Millers River Hydrologic Assessment project, Gomez & Sullivan collected and analyzed average daily discharge data by month for each WWTP and compared it to the permitted monthly average discharge limit for each facility. Except for the Winchendon Water Pollution Control Facility (WPCF), the Athol WWTP and the Orange WWTP, the remaining nine (9) facilities were within their monthly discharge limit for the period 1993-2001. The Orange and Athol violations coincided with spring snowmelt and runoff (March and April). The infiltration of groundwater and the inflow of stormwater into the sewer pipes could be causing the high discharge volumes.[39] Overall, volumes of runoff throughout the watershed are high during these months. As a result, although the volume of wastewater being discharged is in violation of the permit conditions, it is likely that the larger flow volumes in the river will provide some dilution of the wastewater. The Winchendon WPCF was found to be in violation of its 0.5 mgd discharge limit for all months except July, August and September. The town is under a consent decree (July 19, 2000) to upgrade the WPCF to handle an average design flow capacity of 1.1 mgd. The upgraded facility should be on-line by January 2005.[40]

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[37] Information for this section was gathered primarily from Kennedy and Rojko, op.cit.
[38] Gomez & Sullivan, op.cit.
[39] Gomez & Sullivan, op.cit.
[40] Kennedy and Rojko, op.cit.

Industrial Wastewater Treatment Plants and Non-Process Discharges

Most of the industrial process wastewaters are treated at the municipal WWTP. Both the Gardner and Erving-Center WWTP handle significant volumes of industrial process wastewaters. The only significant major industrial discharger in the watershed is Seaman Paper Company in Templeton which discharges into the Otter River. In Athol, the L.S. Starrett Company discharges a small volume of process wastewater and non-contact cooling water into the mainstem of the Millers River.

Institutional Discharges

There is one permitted institutional facility in the watershed that discharges domestic wastewater. The Templeton Development Center, located in Templeton, discharges to Beaver Brook. The permitted flow is 0.05 mgd.

Stormwater

Winchendon, Gardner and Templeton must comply with the requirements of the Phase II NPDES stormwater permits. These requirements include: developing, implementing and enforcing a stormwater management program for their municipal drainage systems to reduce the discharge of pollutants over the five-year term of the permit.

Potential Nonpoint Sources of Pollution

In 2002, a report prepared by the Montachusett Regional Planning Commission and the Franklin Regional Council of Governments was issued that inventoried and assessed the potential sources of nonpoint pollution in the Millers River watershed. The following discussion is a summary of the information contained in this detailed report.[41]

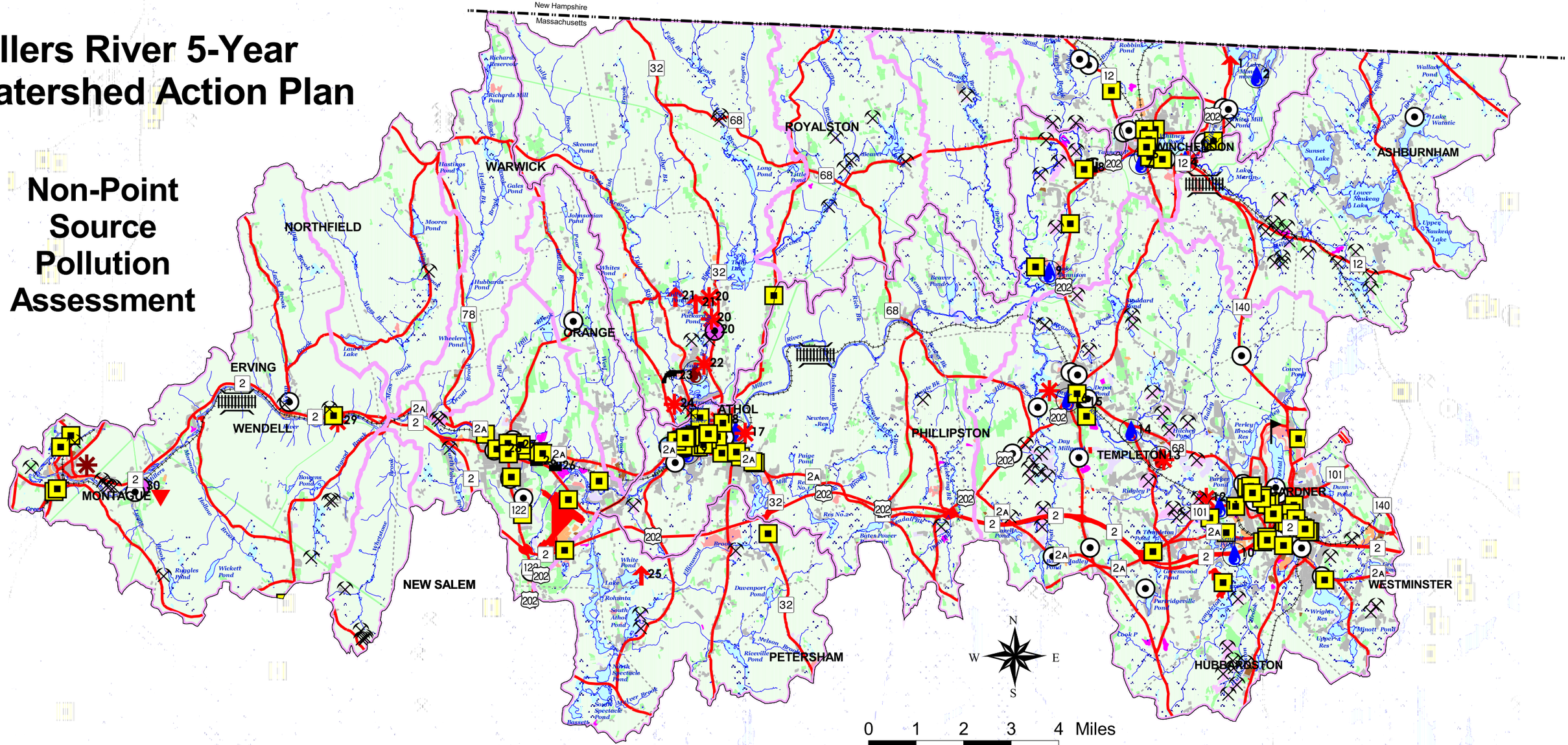
Landfills and Other Solid Waste Disposal Facilities

The 2002 Nonpoint Source Pollution report listed fourteen (14) landfills in the Millers River watershed. As shown in the following table, these landfills include municipal solid waste landfills, construction and demolition debris landfills, and a sludge landfill. Old municipal solid waste landfills often accepted commercial and industrial wastes and septage sludge in addition to household wastes. Even household wastes can contain toxic chemicals such as paints and solvents, cleaning compounds, waste motor oil, pesticides and fertilizers. Though quantities dumped are small to the individual, the cumulative impacts of continuous dumping over many years can be serious for the environment.

[41] For more detailed information, the reader is referred to the document prepared by the Montachusett Regional Planning Commission and the Franklin Regional Council of Governments, "Assessment of Potential Non-Point Source Pollution for the Millers River Watershed in Massachusetts," Project No. 2000-03/604, July 2002.

Millers River 5-Year Watershed Action Plan

Non-Point Source Pollution Assessment



Map Sources:

Map produced by The Franklin Regional Council of Governments Planning Department. GIS data sources include the FRCOG Planning Department, the Massachusetts Highway Department, MassGIS, Massachusetts Natural Heritage and Endangered Species Program, and United States Fish and Wildlife Service. Digital data obtained from MassGIS represent the efforts of the Massachusetts Executive Office of Environmental Affairs and its agencies to record information from the sources cited in the associated documentation. EOEA maintains an ongoing program to record and correct errors in the GIS data that are brought to its attention. EOEA makes no claims as to the reliability of the GIS data or as to the implied validity of any uses of the GIS data. EOEA maintains records regarding all methods used to collect and process these digital data and will provide this information on request. Executive Office of Environmental Affairs, MassGIS EOEA Data Center, 251 Causeway Street, Suite 900, Boston, MA, 617-626-1000.

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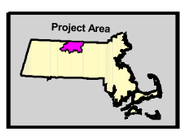
Note: Depicted boundaries are approximate and are intended for planning purposes only. Portions of the source data were obtained from 1:100,000 scale maps, therefore the accuracy of the line work on this map is +/-100 feet.



FRANKLIN REGIONAL COUNCIL OF GOVERNMENTS
Main Office: 413-774-3167
425 Main Street
Greenfield, Massachusetts 01301

September 2004

Potential Nonpoint Sources of Pollution

Map ID No.	Description	Town / Subwatershed	Map ID No.	Description	Town / Subwatershed
1	Potential Septic - Lake Monomonac	Winchendon / North Branch	16	Stormwater quality concerns and Solid Waste dumping along	
2	Stormwater concerns from road drainage			Micheals Lane and Cottage Street	
3	Stormwater concerns at industrial site		17	Stormwater and Solid Waste dumping along Bridge Street	Athol / Middle Millers
4	Solid waste dumping and Stormwater concerns near	Upper Millers	18	Solid Waste dumping end of Greenwood Terrace	
	George Whitney Pond along Ash Street		19	Stormwater quality concerns along Marble Street	
5	Golf Course along Route 12	Middle Millers	20	Solid Waste dumping Royalston Road and Packard Road	Athol / Tully
6	Stormwater concerns at George Whitney Pond along High Street		21	Potential Septic concerns at Tully and Packard Pond	Orange / Tully
7	Stormwater quality concerns with old railroad ties along riverbank		22	Solid Waste dumping and minor riverbank erosion along Pinedale Rd.	
8	Industrial land use near Millers River		23	Lead shot observed in small pond at former sportsman club	
9	Potential Septic problems from swimmers - and stormwater concerns		24	Solid Waste dumping near Western Ave	Orange / Middle Millers
	from road drainage near Lake Dennison		25	Potential Septic Concerns near White Pond	
10	Stormwater and Solid Waste dumping Rt 2A to Mill Street	Gardner / Otter River	26	Abandoned / underutilized industrial site on East River Street	
11	Stormwater quality concerns from Coleman Street to Rt. 2A		27	Stormwater quality concerns Haskins Road	
12	Solid waste dumping along Riverside Road		28	Abandoned / Underutilized industrial site along West River Street	
13	Solid Waste dumping and minor riverbank erosion along Riverside Rd.		29	Solid Waste dumping/concerns along papermill Road and Rt 2	Erving
14	Stormwater concerns along Turner and Bridge Street		30	Closed Wendell Landfill Mormon Hollow Road	Wendell / Lower Millers
15	Abandoned / underutilized industrial site on Mill Street	Gardner / Otter River			

Legend

- State boundary
- Town boundary
- Sub-watershed boundary
- River, stream
- Minor roads
- Major roads
- Rail line
- National Wetland Inventory wetland
- Water body
- Gravel pit
- Underground storage tank
- Chapter 21E site

Potential non-point sources

- Industrial site
- Illegal junkyard/dumping site
- Stream bank erosion
- Storm run-off
- Closed landfill
- Suspected septic problems
- Golf course
- Groundwater discharge
- Lead shot
- Railroad defoliant
- Odors in river
- Construction/demolition debris

1-30 Potential nonpoint sources of pollution (see table)

Land Use (1999)

- Forest
- Open, abandoned field/orchard, crop, pasture, nursery
- Non-forested wetland
- Mining, gravel pit
- Golf and skiing facilities
- Spectator recreation
- Water-based recreation
- Residential
- Commercial
- Industrial
- Urban open (parks, cemeteries, public and institutional greenspace, vacant undeveloped lands)
- Transportation
- Waste disposal

Only one of the fourteen landfills in the watershed has a liner beneath the waste. Liners can help to prevent the migration of contaminated leachate into ground and surfaced waters. The remaining landfills are unlined. Many of the landfills have not been capped. When a landfill is closed, layers of impermeable material (typically plastic and clay) are placed over the landfill to prevent rainwater and melting snow from percolating down into the refuse and generating contaminated leachate. Unfortunately, many of these old landfills were sited in or adjacent to floodplains or wetlands, or on top of aquifers that provide drinking water. Although the federal and state regulations governing landfill operation and closure require regular groundwater monitoring, the Board of Health should also be vigilant about monitoring a landfill in their community, particularly if the landfill is located in an environmentally sensitive area. Such on-site monitoring could include periodic inspections of the integrity of the cap, the proper functioning of the leachate collection system (if installed), "break-outs" of leachate or waste at the toe of the slope, unusual odors or sheens on nearby surface waters, etc. Citizen volunteers can also help to monitor landfills in the watershed. Several years ago, the volunteers of the Tully River Stream Team identified a plume of "orange goo" coming from a drainage pipe at the closed Athol landfill on West Royalston Road. The landfill is located 2.5 miles upstream of the Zone II for Athol's Tully Well fields and South Street Well. Also noted were the effects of recent beaver activity which caused a rise in surface water levels that backed up to the toe of the landfill. This type of information can be valuable for regulators and town officials who are responsible for mitigating the environmental impacts of the landfill and protecting drinking water supplies and other resource areas.

Other waste management sites within the Millers River watershed are also tracked by the state. The 2002 Nonpoint Source Pollution Report lists information for 52 additional waste sites, including: unpermitted landfills, auto dumps and wastewater filter beds (see Table 2-8).

Illegal Dumping

Like many rural areas of the state, the practice of illegal dumping occurs throughout the watershed. Some of these illegal dumps are abandoned sites that are 50 to 100 years old. Others are areas that are secluded or hidden, where people dump unwanted refuse such as old appliances, waste motor oil, old tires, and hazardous chemicals. Such sites are typically found along riverbanks at the back edges of commercial and residential properties or on properties with heavy brush vegetation that appear to be abandoned open spaces. Volunteer Stream Team members located some of these sites during their work in the Otter River and Tully River subwatersheds. Illegal dump sites can pose a serious threat to the groundwater and surface water since they are not monitored and leachate can travel great distances before it is detected.

Table 2-7

Solid Waste Facilities in the Millers River Watershed[42]

Solid Waste Site	ACRES	Type	Status	Year Opened	Year Closed	Design
Ashburnham Landfill 356 Winchendon Rd (Rte 12), Ashburnham	5.6	SANITARY Landfill	Active	1971	1999	Partially Capped, Not Lined
Winchendon Landfill River St, Winchendon	11.3	SANITARY Landfill	Active	N/A	1998	Not Capped, Not Lined
Royalston Landfill 6 Town Dump Rd, Royalston	3.6	SANITARY Landfill	Active (transfer station)	1913	1998	Capped, Not Lined
Gardner Landfill West St (Rte 68), Gardner	37.1	SANITARY Landfill	Active	1911	1998	Not Capped, Not Lined
Athol Landfill West Royalston Rd, Athol	16.3	SANITARY Landfill	Closed	1955	1993	Capped, Not Lined
Templeton Landfill King Philip's Trail (Rte 202), Templeton	7.5	SANITARY Landfill	Closed	N/A	1995	Capped, Not Lined
Hutchinson Dump Hubbardston Rd, Templeton	2.6	SANITARY Landfill	Inactive	1974	1975	Not Capped, Not Lined
CJ Mabardy demolition Landfill 637 River St, Winchendon	8.1	DEMO Landfill	Inactive	N/A	1986	Unknown Cap, Not Lined
Erving Paper Sludge Landfill Rte 2, Erving	7.0	SLUDGE Landfill	Active	1977	1998	Not Capped, Not Lined
Mormon Hollow Demo Landfill Mormon Hollow Rd, Wendell	21.3	DEMO Landfill	Active	1990	1997	Partially Capped, Lined
Wendell Landfill New Salem Rd, Wendell	2.1	SANITARY Landfill	Inactive	1960	1990	Not Capped, Not Lined
Orange Landfill Jones St, Orange	30.4	SANITARY Landfill	Inactive	N/A	1997	Partially Capped, Not Lined
Drew Demolition Landfill Evergreen St, Orange	2.1	ILLEGAL Other	Inactive	N/A	N/A	Unknown Cap, Not Lined
Erving Landfill Zilinski Rd, Erving	29.7	SANITARY Landfill	Inactive	N/A	N/A	Unknown Cap, Not Lined

[42] Table adapted from Montachusett Regional Planning Commission and Franklin Regional Council of Governments, op.cit.

Underground Storage Tanks

An underground storage tank (UST) is defined as a tank and any underground piping connected to the tank that has at least 10 percent of its combined volume underground. USTs are typically used to store gasoline and heating oil, however, USTs can also be used to store hazardous wastes and manufacturing chemicals such as solvents. State and federal regulations require that existing and new underground storage tanks (except those used for farming and residential uses) be registered and inspected on a regular basis. Permits and inspection reports are filed with local Fire Departments. Towns can adopt bylaws to regulate the construction, installation, operation, and maintenance of USTs in environmentally sensitive areas, particularly Zone II areas of public water supplies. The 2002 Nonpoint Source Pollution Assessment Report for the Millers River Watershed listed 93 registered tanks in the watershed.

Winter Road Maintenance, Salt Storage and Snow Dumping Areas

Winter storm road maintenance is a combination of sand/salt application and plowing. The ratio of sand to salt used in the mixture varies by municipality and with the severity and temperature of each storm event. In colder temperatures more sand is used, to provide traction and to keep roads from developing ice due to salt application. At higher temperatures more salt is used. Snow storms that occur in the late winter/early spring, when stormwater runoff and snowmelt are greatest, increase the potential for high concentrations of salt to flow into surface waters and infiltrate groundwater. Excess sand accumulates on the roadways, blocks storm drains and swales, and increases the sedimentation of streams and rivers especially at culverts and stormwater discharge pipes.

Many communities in Massachusetts have designated areas where salt application is significantly reduced or curtailed, in response to concerns about groundwater and well water contamination. The State has also designated selected areas. Communities in the Millers River watershed may have adopted such areas, as well.

Snow removal practices can be a direct source of salt, sediment, and other road related contaminants to rivers, streams and lakes. Snow dumping can result in a prolonged period of salt and contaminant release, since large snow piles take time to melt. Snow removal contractors should try to locate snow piles away from sensitive areas. Where snow is collected on-site at large parking lots, it should be piled away from the storm drainage system. Ideally the storm drainage system should incorporate measures for removal of sediments and road chemicals before release to the ground or surface waters. Lot owners should be educated about the impacts of snow storage or dumping. Dumping of snow over the edge of river embankments should be prohibited.

Table 2-8
Additional Waste Management Sites in Millers River Watershed[43]

Street	Town	Acres
Lincoln Avenue	Winchendon	10.9
Spring Street	Winchendon	14.9
Hospital Road	Templeton	6.2
Reservoir Street	Templeton	37.3
Waste Water Road off Mohawk Trail	Erving	6.8
Waste Water Road off Mohawk Trail	Erving	3.6
Maple Avenue	Erving	1.4
West Main Street	Orange	6.0
Maple Avenue	Erving	4.2
off Fernald School Road	Templeton	3.9
Water Pollution Control Road off River Road	Erving	3.6
Water Pollution Control Road off River Road	Erving	2.3
South Athol Road	Athol	3.1
Royalston Road	Phillipston	7.6
South Main Street, Baldwinville	Templeton	17.7
Pine Crest Road	Orange	8.0
Old State Road	Orange	10.2
Pine Crest Drive	Orange	8.5
Pine Crest Drive	Orange	5.8
off Gardner Road, East Templeton	Gardner	19.5
Coburn Avenue	Gardner	2.2
off Gardner Road, East Templeton	Templeton	27.9
Baldwinsville Road	Phillipston	9.2
West Broadway	Gardner	3.4
Eagleville Road	Orange	2.4
Eagleville Road	Orange	2.2
Kinzer Drive	Gardner	2.3
Timpany Boulevard	Gardner	5.5
Main Street South	Templeton	4.3
State Road West	Westminster	3.8
East Broadway	Gardner	4.8
Toby Street	Gardner	4.9
East Chestnut Hill Road	Montague	1.2
Riceville Road	Athol	2.3
Hubbardston Road	Templeton	12.1
Cross Road	Templeton	15.9
Monson Turnpike	Petersham	0.5
Monson Turnpike	Petersham	0.4
South Athol Road	New Salem	1.6
South Athol Road	New Salem	3.0

[43] Table adapted from Montachusett Regional Planning Commission and Franklin Regional Council of Governments, op.cit.

As part of the 2002 Nonpoint Source Assessment Report for the Millers River Watershed, MRPC conducted a telephone survey of the local Departments of Public Works (DPWs) to obtain the locations of the sand/salt storage barns and winter road maintenance practices. The locations of all the private salt storage facilities (if any) in the watershed have not been identified. The results of the telephone survey indicate that all the salt piles are stored in buildings.

Untreated Road Runoff

Urban development and sprawling residential development in rural areas alter the natural hydrology of an area. Where natural vegetation and soil structure once allowed the gradual absorption and filtering of rain and snowmelt, the impervious surfaces of buildings, parking lots, and roads speed the delivery of both water and pollutants to nearby waterways. Rain and melting snow flush pollutants, such as sediment, bacteria, oil and other automotive fluids, pesticides and fertilizers, from yards, parking lots and streets into storm drains that then dump this contaminated water into rivers and lakes.

Ordinary citizens contribute to polluted runoff in many ways, often without realizing it. Car washing and maintenance can release salts, anti-freeze, and oils onto the pavement and then into storm drains and ditches. Pollutants from vehicle exhaust and backyard burning eventually settle to the ground and are washed into adjacent waterbodies during the next storm event. Households with lawns or gardens use more chemicals on a given area than commercial growers. Excess amounts of these compounds find their way into the soil, groundwater and adjacent surface waters.

Industrial and commercial businesses also contribute pollutants to stormwater runoff through accidental spills and leaks, and through use and discharge of potentially toxic compounds. Many industries are required by their liquid waste management permits to collect, monitor, or treat stormwater. However, uncontrolled runoff from some industries remains a significant problem and efforts to replace harmful compounds with environmentally safe, yet effective, alternatives can be challenging.

Highway stormwater runoff combines the worst of industrial and residential runoff with erosion and sedimentation from roads and road salt. Many towns try to manage sedimentation through street sweeping programs. Table 2-10 lists the towns in the watershed with street sweeping programs according to a 2002 telephone survey of local departments of public works. The survey did not reveal during what season the street sweeping occurred.

Sand and Gravel Operations

The mining of resources such as sand and gravel for product or construction purposes can have water quality and aquatic habitat impacts. Silt and sediment can be eroded and deposited into water resources if proper controls are not established. Sorting, washing, and other processing of extracted resources and disposal of waste products may affect nearby waterways. Most importantly, large resource extraction operations can result in severe modifications to the hydrology of an area, including reducing the amount of recharge to the groundwater and the alteration (draining) of nearby wetlands. In addition, these pits can be a

"direct conduit" for pollutants to enter the groundwater. This is of particular concern for abandoned sites that have not been restored. Oftentimes, these pits can become illegal dumps.

Table 2-9

Phone Survey of Local Departments of Public Works[44]

Municipality	What is (are) the location of your public salt/sand storage barn(s)?	Are they housed in salt sheds?	What is the sand/salt ratio used by the department?	How is the sand/salt ratio determined?	Are there any low-salt areas in town?	Does the town haul away any snow during heavy storms?	Where is the snow dumped or stockpiled?	Do you know of any businesses that have their snow hauled away?
Ashburnham	17 Central St.	Yes	3:1		Near Reservoir	No		
Athol	Petersham Rd.	Yes	240/mile	Set Standard	Rt 32 at Rt 122. Rt 2A from Rt 32 to Templeton TL	No		
Erving	Maple Ave	Yes	10 lbs to 18 Yds.	Town Well Protection	The entire town.	No		
Gardner	At DPW	Salt yes, Sand no	3:1	Temperature and Forecast	Around the Watershed	Yes	Behind DPW	Many, but unsure of destination
Hubbardston	At DPW	Yes	Varies	Weather	No	No		
Orange	526 East River St.	Yes	Triax 18-20, 3 yds Salt	Weather	No	Yes	Near Salt Shed	
Phillipston	1/4 mile from Common	Yes	5:1 6:1 3:1	Time of Year	No	No		
Royalston	20 Winchendon Rd.	Yes	3:1	Weather	Royalston Common Area. Well Areas.	No		
Templeton	381 Baldwinville Rd.	Yes		Weather				
Warwick	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wendell	Lockes Village Rd.	Yes	N/A	N/A	N/A	N/A	N/A	N/A
Westminster	2 Oakmont Ave.	Yes	1:1	Weather	South St.	No		
Winchendon	Glenallen St.	Yes	5:1	Road Conditions	No	Yes	Off of Webster St.	

[44] Table adapted from Montachusett Regional Planning Commission and Franklin Regional Council of Governments, op.cit.

Table 2-10

Millers River Watershed Street Sweeping[45]

Town	Street Sweeping Schedule
Ashburnham	Once Yearly
Athol	Not swept
Erving	Once Yearly
Gardner	Twice Yearly
Hubbardston	Hired Out Schedule undetermined
Orange	Hired Out Once Yearly
Phillipston	Once Yearly
Royalston	Once Yearly
Templeton	Twice Yearly
Warwick	N/A
Wendell	N/A
Westminster	Once Yearly
Winchendon	Once Yearly

According to the 2002 Nonpoint Source Pollution Report, there are thirty-eight (38) sites in the watershed identified as sand, gravel, or mining. All of these sites are located in areas where sand and gravel deposits exceed 50 feet in depth. Not surprisingly, many of these permeable deposits also coincide with recharge areas for aquifers and the floodplains along the Otter and Millers Rivers. The 2002 Nonpoint Source Assessment Report identified only five (5) active sand and gravel companies in the watershed based on listings in the Verizon Yellow Pages. At this point, it is not known how many of the 38 identified mining sites are active or abandoned and which of these sites are owned by the five active sand and gravel companies.

Surface Water Quality Standards

All of the potential point and nonpoint sources of pollution described above, together with alterations to natural streamflow conditions, can lead to environmental degradation and loss of important human uses of streams and waterbodies. To control and monitor water quality, the Massachusetts Surface Water Quality Standards (SWQS) were developed to establish categories of waters (Class A, Class B, and Class C) which are based on their highest and best use, and to establish the most sensitive uses for which surface waters in the state shall be protected (Designated Uses).

Surface Water Classification[46]

Class A: These are surface waters (does not include groundwater supplies) that are

[45] Table adapted from Montachusett Regional Planning Commission and Franklin Regional Council of Governments, op.cit.

[46] Information for this section adapted from Kennedy and Rojko, op.cit.

designated as a source of public water supply. To the extent compatible with the use as a public water supply, these waters shall be excellent habitat for fish and other aquatic life and wildlife, and be suitable for primary and secondary contact recreation. These waters shall have excellent aesthetic value.

Class A waters are protected as Outstanding Resource Waters (ORW) under 314 CMR 4.04(3). The designation of ORW is given to those surface waters with exceptional socio-economic, recreational, ecological and/or aesthetic values. Because of their value, ORWs have more stringent regulations than other waters because the existing use is so exceptional or the perceived risk of harm is such that no lowering of water quality is permissible. ORWs also include certified vernal pools. Within the Millers River Watershed, there are approximately 114 certified vernal pools. Wetlands that border ORWs are designated as ORWs to the boundary of the defined area.

Class A waterbodies in the Millers River Watershed include:

- Upper Naukeag Lake, source to outlet in Ashburnham and those tributaries thereto
- Newton Reservoir, source to outlet in Athol and those tributaries thereto
- Phillipston Reservoir, source to outlet in Phillipston and those tributaries thereto
- Crystal Lake, source to outlet in Gardner and those tributaries thereto
- Cowee Pond, source to outlet in Gardner and those tributaries thereto
- Perley Brook Reservoir, source to outlet in Gardner and those tributaries thereto
- Reservoirs #1 and #2, source to outlet in Athol and those tributaries thereto
- Lake Mattawa (North Pond Brook Reservoir), source to outlet in Orange and those tributaries thereto
- Lake Ellis (Ellis Pond), source to outlet in Athol and those tributaries thereto

Class B: These waters are designated as habitat for fish and other aquatic life and wildlife. These waters are designated for primary and secondary contact recreation. With appropriate treatment, these waters may be designated as a source of water supply. Class B waters are suitable for irrigation and other agricultural purposes and for compatible industrial cooling and process uses. Class B waters shall have consistently good aesthetic value.

Class B Cold Water Fishery in the Millers River Watershed

- Millers River, source to Winchendon Water Pollution Control Facility
- Beaver Brook, Templeton Developmental Center to confluence with the Millers River

Class B Warm Water Fisheries in the Millers River Watershed

- Millers River, Winchendon Water Pollution Control Facility to confluence with the Connecticut River

- Otter River, Gardner Wastewater Treatment Plant to confluence with Millers River

Class B Aquatic Life* in the Millers River Watershed

- Otter River, Source to Gardner Wastewater Treatment Plant
  (*This designation is made only where background conditions prevent the attainment of a "higher use" designation. In these waters, Class C dissolved oxygen and temperature criteria apply.)

Waters in the Millers River Watershed that are not otherwise designated in the SWQS are designated ***Class B, High Quality Waters***. According to the SWQS, where fisheries designations are necessary, they shall be made on a case-by-case basis.

Designated Uses

The designated uses in the SWQS include: Aquatic Life, Fish Consumption, Drinking Water, Primary and Secondary Contact Recreation, and Aesthetics. The Massachusetts Department of Environmental Protection (MA DEP) recently completed a comprehensive assessment of water quality conditions in the Millers River Watershed.[47] A total of 14 rivers, streams or brooks were assessed in the MA DEP report. Collectively, these waterbodies represent 48% of the named river miles (117.1 of 242.2 miles) in the watershed. Sixty-four (64) of the 100 lakes, ponds, and impoundments were also assessed by the MA DEP, representing 93% of the total lake acreage (3,833 of 4,121 acres).

MA DEP reviewed available data for each identified river segment and lake and then determined which of the designated uses could be assessed as either ***Support*** or ***Impaired***. For river segments and lakes where there is little available current data or no reliable data is available, the use is ***Not Assessed***. However, if the segment or lake shows some evidence of water quality impairment that is not naturally occurring, the use is identified with an ***"Alert Status"***. A summary of the criteria used for assessing whether a designated use is classified as ***Support*** or ***Impaired*** and a summary of the status of the assessed river segments and lakes are provided below**.**[48]

Aquatic Life Use is supported when suitable habitat is available for sustaining a native, naturally diverse community of aquatic flora and fauna. Impairment may result from point or nonpoint sources of pollution, hydrologic modification or, in the case of lakes, an infestation of non-native aquatic vegetation.

> <u>Rivers</u>: Of the 117.1 river miles assessed, 74.2 miles (63%) are assessed as ***Support***; 28.9 miles (25%) are assessed as ***Impaired***; and 14 miles were ***Not Assessed***. The impaired river miles include the lower 9.9 miles of the Otter River and 19 miles of mainstem of the Millers River. The primary cause of impairment is PCB (polychlorinated biphenyl) contamination in sediment and whole fish. The current source of PCBs in river water is contaminated sediments. The original source of contamination is believed to be the discharge of wastewater from the

[47] Kennedy and Rojko, op.cit.
[48] Kennedy and Rojko, op.cit.

former Baldwinville Products Mill (now owned by American Tissue Mills). Other sources of impairment in these segments include hydromodification (changes in the flow conditions of the river), degradation of habitat, slightly elevated levels of total phosphorus (nutrient) and toxicity to aquatic life (from treatment plant effluent and/or ambient conditions). Due to lack of data, the upper reaches of the Millers and Otter Rivers as well as the North Branch Millers River and both branches of the Tully River, which represent 12% of the river miles in the watershed, are currently **Not Assessed** for the *Aquatic Life Use*.

Lakes: Only a small number of lakes in the watershed have been recently sampled for parameters that can be used to assess the status of the Aquatic Life Use (e.g., dissolved oxygen, pH, nutrients, macrophytes and plankton/chlorophyll). Therefore, because of a lack of data, most of the lakes in the Millers River Watershed are classified as **Not Assessed** for the *Aquatic Life Use*.

Eight lakes (8), Ellis Pond, Parker Pond, South Athol Pond, White Pond, Lake Monomonac, and Lake Rohunta, are assessed as ***Impaired*** for the *Aquatic Life Use* because they are infested with non-native aquatic vegetation, either *Cabomba caroliniana* (fanwort), *Myriophyllum heterophyllum* (variable water milfoil), and/or *M. spicatum* (Eurasian water milfoil). The total area of these lakes is approximately 809 acres. Because of an unconfirmed report of variable water milfoil, the Aquatic Life Use for Sunset Lake is identified with an ***Alert Status***.

Fish Consumption Use is supported when there are no pollutants present that result in unacceptable concentrations in edible portions of marketable fish or for the recreational use of fish, other aquatic life or wildlife for human consumption. In July 2001, the Massachusetts Department of Public Health (MA DPH) issued a statewide advisory on fish consumption due to elevated mercury and PCB levels in edible portions of fish.

Rivers: Because of elevated levels of mercury and PCBs in edible portions of fish, MA DPH issued fish consumption advisories for the mainstem of the Millers River and all of its tributaries. Therefore, the *Fish Consumption Use* for all rivers in the watershed is assessed as ***Impaired***. However, the MA DPH advisory does not include fish stocked by the state Division of Fisheries and Wildlife. As mentioned above, the original source of PCB-contaminated sediment is believed to be due to historic discharges from the former Baldwinville Products Mill. The source of mercury is unknown, although atmospheric deposition is the likely source.

Lakes: The MA DPH has issued fish consumption advisories for eight lakes in the Millers River Watershed, including: Gales Pond, Whitney Pond, Lake Dennison, Lake Rohunta, Upper Naukeag Lake, and Upper Reservoir. These lakes are listed as ***Impaired*** because of health concerns related to elevated levels of mercury in edible portions of fish. The majority of the lakes in the Millers River Watershed default to ***Not Assessed*** for the *Fish Consumption Use* because of the statewide advisory. Sources of mercury in this area are currently unknown, although atmospheric deposition is suspected.

Drinking Water Use is used to indicate sources of public drinking water (these sources include a segment of a river, or a lake or other impoundment). These waters are strictly regulated by the state under the Massachusetts Drinking Water Regulations; they were not assessed as part of the MA DEP Millers River Watershed 2000 Water Quality Assessment Report. Public water suppliers are required to regularly monitor their finished water (water that emerges from your faucet) for a suite of contaminants. Information on drinking water quality and source protection efforts is available in the "Consumer Confidence Reports" that public water suppliers are required to issue each year. These reports are available from the public water supplier, local boards of health, MA DPH and MA DEP. The lakes and reservoirs that serve as public water supplies in the Millers River Watershed are listed below.

- *Upper Naukeag Lake*
- *Newton Reservoir*
- *Phillipston Reservoir*
- *Crystal Lake*
- *Cowee Pond*
- *Perley Brook Reservoir*
- *Reservoirs #1 and #2*
- *Lake Mattawa (North Pond Brook Reservoir)*
- *Lake Ellis (Ellis Pond)*

Primary Contact Recreation Use is supported when conditions are suitable for any activity where there is prolonged contact with the water and there is a significant likelihood of ingesting the water (swimming, wading, water skiing). Fecal coliform bacteria, densities, turbidity and aesthetics meet the SWQS.

Secondary Contact Recreation Use is supported when conditions are suitable for any activity where contact with the water is either incidental or accidental (fishing, boating).

Aesthetic Use is supported when surface waters are free from pollutants that settle to form objectionable deposits; float as debris; scum or other matter; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

<u>*Rivers*</u>: Most of the river miles (92%) in the watershed are ***Not Assessed*** for the Primary and Secondary Contact Recreation Uses because of the lack of current bacteria data. The lower 9.9 miles of the Otter River are ***Impaired*** for the *Primary* and *Secondary Contact Recreation* and *Aesthetic Uses* because of turbidity. The suspected sources of impairment for this reach of the Otter River include sand and gravel operations and road runoff from construction activities. The *Aesthetics Use* is assessed as ***Support*** for 73% of the river miles.

<u>*Lakes*</u>: Because of the lack of fecal coliform bacteria data, 90% of the lake acreage in the watershed is classified as **Not Assessed** for the *Primary* and *Secondary Contact Recreational* and *Aesthetic Uses*. Data is available for five lakes, Dunn Pond, Ruggles Pond, Lake Dennison, Lake Mattawa, and Laurel Lake and these lakes are assessed as ***Support*** for the *Primary* and *Secondary Contact*

Recreational and *Aesthetic Uses*. None of the lakes in the Millers River Watershed are assessed as ***Impaired*** for the *Primary* and *Secondary Contact Recreational* and *Aesthetic uses*.

The following four fold-out maps which summarize the most current status for designated uses in the watershed were prepared by the Massachusetts Department of Environmental Protection (MA DEP) as part of the 2000 Millers River Watershed Water Quality Assessment Report. These maps are included in this Watershed Action Plan courtesy of the MA DEP.

MILLERS RIVER WATERSHED

Aquatic Life Use Assessment Summary – Rivers and Lakes

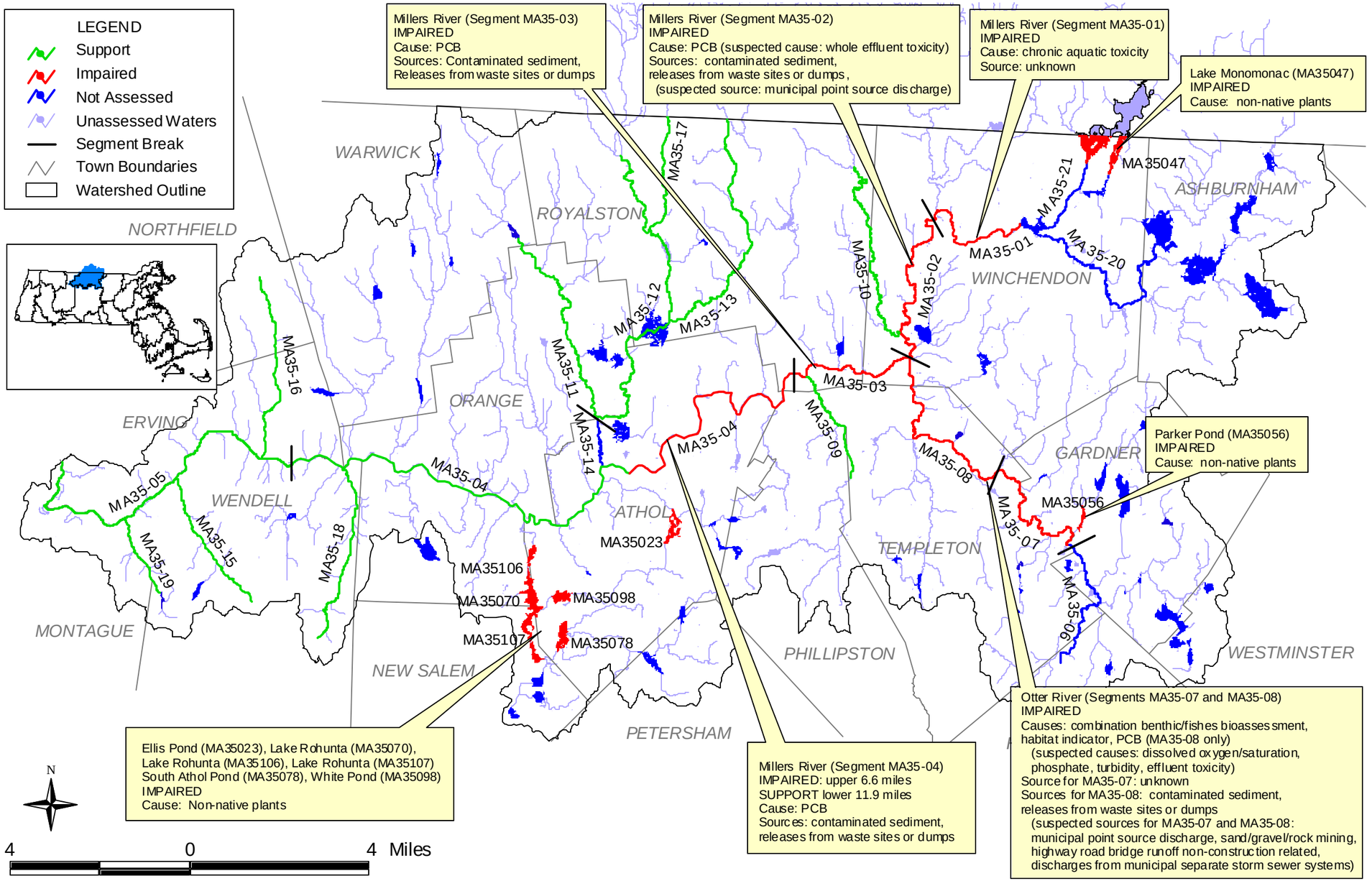


Figure 1. Millers River Watershed *Aquatic Life Use* Assessment Summary – Rivers and Lakes

MILLERS RIVER WATERSHED

Fish Consumption Use Assessment Summary – Rivers and Lakes

The current MA DPH site-specific fish consumption advisory for rivers (MA DPH 2002):
Millers River (all towns from Erving to Winchendon) because of mercury and PCBs:
1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this waterbody **and its tributaries**"
2. "The general public should not consume any brown trout or American eel taken from this waterbody downstream from its confluence with the Otter River."
3. "The general public should limit consumption of all non-affected fish from this waterbody and its tributaries to two meals per month."

Otter River, within ½ mile of the Millers River (Templeton and Winchendon) because of PCBs:
1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish taken from this waterbody."
2. "The general public should not consume any white sucker or brown bullhead taken from this waterbody."

Site-specific advisories for lakes in the watershed were based on results of fish contaminant monitoring.

The current MA DPH statewide advisory (MA DPH 2001):
The MA DPH "is advising pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age to refrain from eating the following marine fish; shark, swordfish, king mackerel, tuna steak and tilefish. In addition, MA DPH is expanding its previously issued statewide fish consumption advisory which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age (MA DPH 2001)." Additionally, MA DPH "is recommending that pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age limit their consumption of fish not covered by existing advisories to no more than 12 ounces (or about 2 meals) of cooked or uncooked fish per week. This recommendation includes canned tuna, the consumption of which should be limited to 2 cans per week. Very small children, including toddlers, should eat less. Consumers may wish to choose to eat light tuna rather than white or chunk white tuna, the latter of which may have higher levels of mercury (MA DPH 2001)." MA DPH's statewide advisory does not include fish stocked by the state Division of Fisheries and Wildlife or farm-raised fish sold commercially.

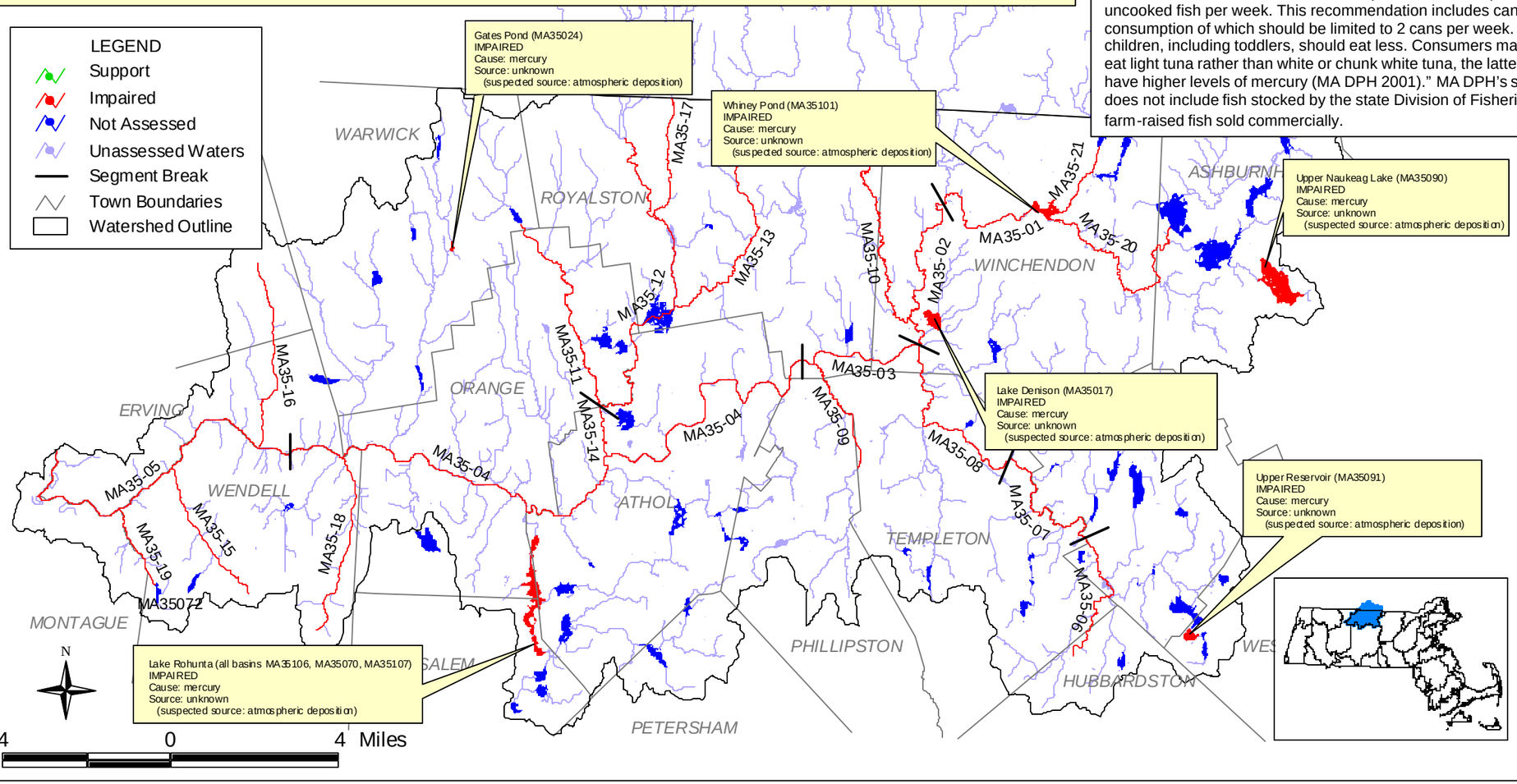


Figure 2. Millers River Watershed *Fish Consumption Use* Assessment Summary – Rivers and Lakes

MILLERS RIVER WATERSHED

Primary and Secondary Contact Recreational Uses Assessment Summary – Rivers and Lakes

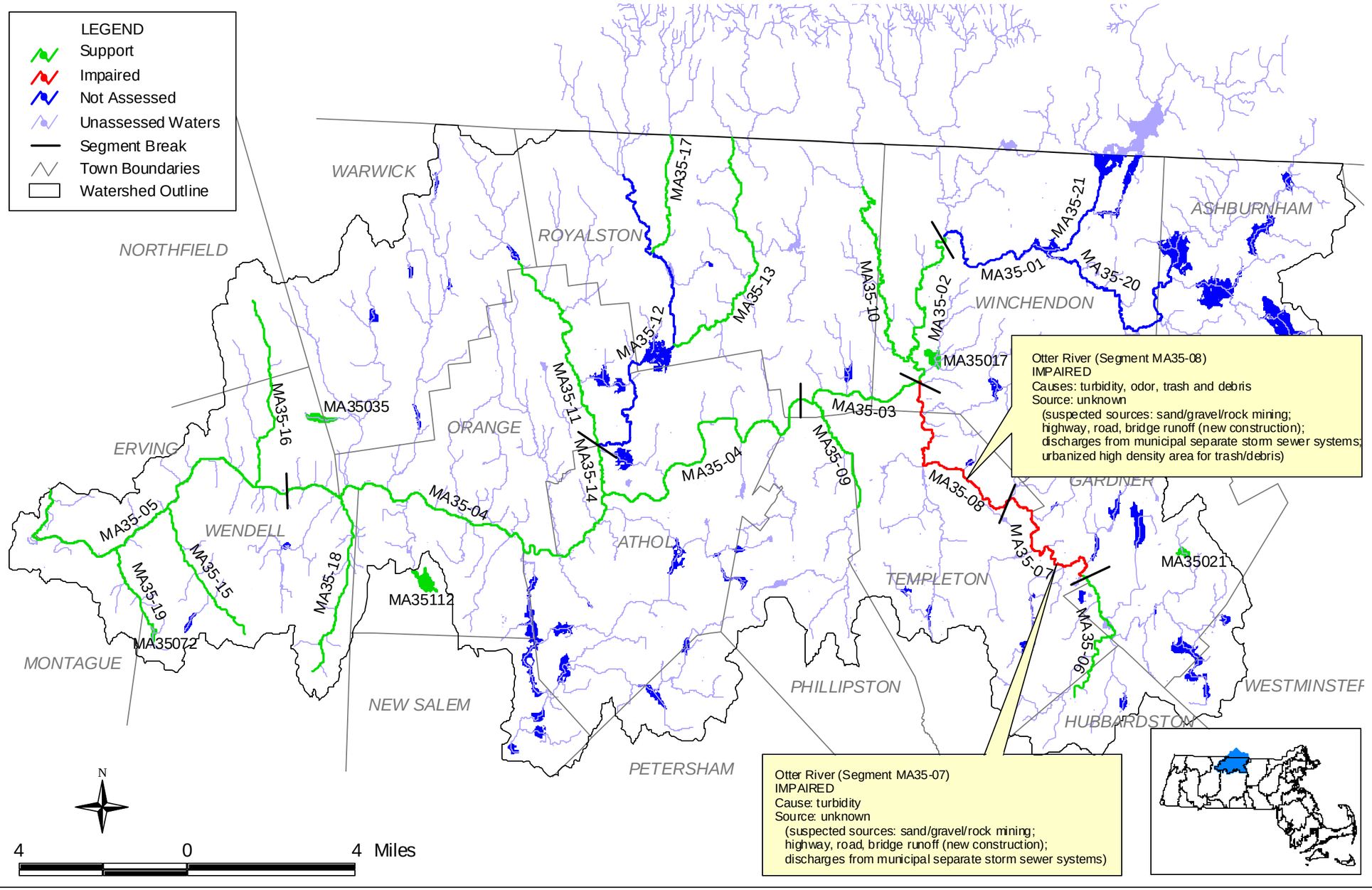


Figure 3. Millers River Watershed *Primary and Secondary Contact Recreational Uses* Assessment Summary – Rivers and Lakes

MILLERS RIVER WATERSHED

Aesthetics Use Assessment Summary – Rivers and Lakes

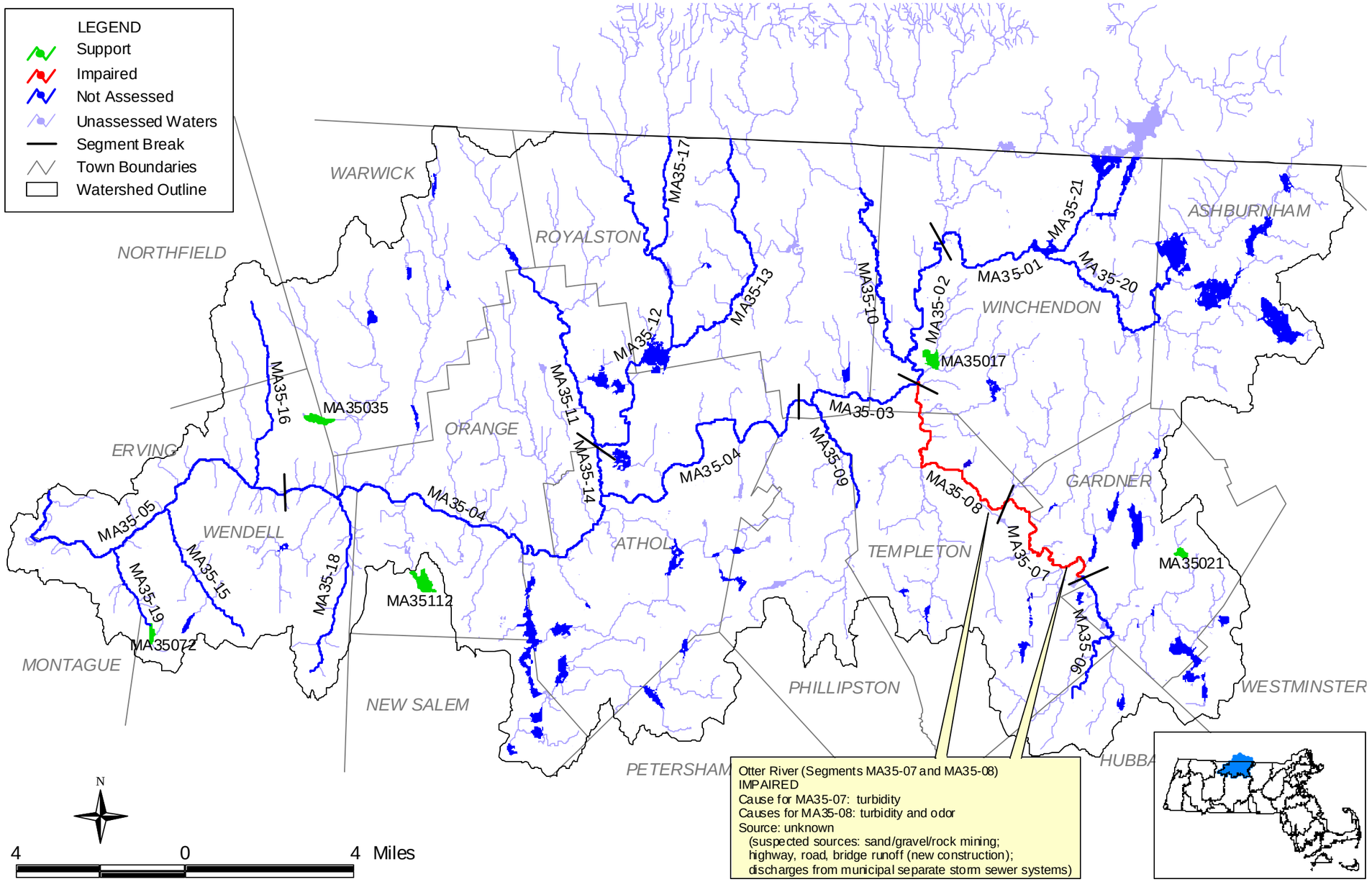


Figure 4. Millers River Watershed *Aesthetics Use* Assessment Summary – Rivers and Lakes

Impaired Waterbodies

The Clean Water Act Section 303(d) requires states to identify those waterbodies that are not meeting standards and prioritize the development of total maximum daily loads (TMDLs) for the various pollutants that are causing impairment of these waterbodies (i.e., phosphorus for lakes). Table 2-11 identifies the waterbodies in the Millers River Watershed on the Final Massachusetts Year 2002 Integrated List of Waters.

The Integrated List includes the following categories:

- **Category 1** Waters that are unimpaired and not threatened for all designated uses.
- **Category 2** Waters that are unimpaired for some uses and not assessed for other uses.
- **Category 3** Waters for which insufficient information is available to make assessments for any uses.
- **Category 4** Waters that are impaired or threatened for one or more uses but not requiring the calculation of a TMDL.
    - **Category 4a** TMDL is completed
    - **Category 4b** Waters expected to attain all designated uses in the near future
    - **Category 4c** Impairment not caused by a pollutant
- **Category 5** Waters that are impaired or threatened for one or more uses and require the calculation of a TMDL.

Table 2-11 Massachusetts Year 2002 Integrated List of Waters for the Millers River Watershed[49]

NAME	SEGMENT ID	DESCRIPTION	ASSESSMENT DATE	CATEGORY
Millers				
Bassett Pond (35002)	MA35002_2002	New Salem	Sep-96	2
Beaver Brook (3523600)	MA35-09_2002	Fernald School discharge, Templeton to confluence with Millers River, Royalston.	Sep-97	5
Beaver Flowage Pond (35005)	MA35005_2002	(Beaver Pond) Royalston	Sep-96	3
Bents Pond (35006)	MA35006_2002	Hubbardston	Sep-96	2
Bents Pond (35007)	MA35007_2002	Gardner	Feb-97	5
Bourn-Hadley Pond (35008)	MA35008_2002	Templeton	Sep-96	3
Bowens Pond (35009)	MA35009_2002	Wendell	Sep-96	3
Boyce Brook (3523400)	MA35-17_2002	NH State Line, Royalston to confluence with East Branch Tully River, Royalston. Miles 3.4-0.0	Sep-97	3
Brazell Pond (35010)	MA35010_2002	Templeton	Sep-96	3
Cowee Pond (35013)	MA35013_2002	Gardner	Sep-96	3
Crystal Lake (35014)	MA35014_2002	Gardner	Feb-97	2
Davenport Pond (35015)	MA35015_2002	Petersham/Athol	Feb-97	3
Lake Denison (35017)	MA35017_2002	Winchendon	Feb-97	5
Depot Pond (35018)	MA35018_2002	(Railroad Pond) Templeton	Feb-97	3
Dunn Pond (35021)	MA35021_2002	Gardner	Feb-97	2
East Branch Tully River (3523275)	MA35-12_2002	Orange/Athol. Miles 10.5-0.0	Sep-97	5
East Templeton Pond (35022)	MA35022_2002	Templeton	Feb-97	3
Ellis Pond (35023)	MA35023_2002	Athol	Feb-97	4c
Gales Pond (35024)	MA35024_2002	Warwick	Feb-97	5
Greenwood Pond (35025)	MA35025_2002	Westminster	Feb-97	3
Greenwood Pond (35026)	MA35026_2002	Templeton	Feb-97	3
Hastings Pond (35028)	MA35028_2002	Warwick	Feb-97	3
Hilchey Pond (35029)	MA35029_2002	Gardner	Feb-97	5
Kendall Pond (35034)	MA35034_2002	Gardner	Dec-99	3
Keyup Brook (3522375)	MA35-16_2002	Headwaters Great Swamp Northfield State Forest, Northfield, to confluence with Millers River, Erving.	Jul-97	3
Laurel Lake (35035)	MA35035_2002	Erving/Warwick	Feb-97	5
Lawrence Brook (3523325)	MA35-13_2002	New Hampshire state line, Royalston through Doane Falls to confluence with East Branch Tully River	Sep-97	5
Little Pond (35037)	MA35037_2002	Royalston	Feb-97	2
Lower Naukeag Lake (35041)	MA35041_2002	Ashburnham	Dec-99	3
Lake Mattawa (35112)	MA35112_2002	Orange	Dec-99	2
Millers River (3522150)	MA35-01_2002	Outlet of Whitney Pond, Winchendon to Winchendon WWTP, Winchendon. Miles 37.7-35.7	Dec-99	5
Millers River (3522150)	MA35-02_2002	Winchendon WWTP, Winchendon to confluence with Otter River, Winchendon. Miles 35.7-30.4	Sep-97	5
Millers River (3522150)	MA35-03_2002	Confluence with Otter River, Winchendon to South Royalston USGS Gage, Miles 30.4-25.6	Sep-97	5
Millers River (3522150)	MA35-04_2002	South Royalston USGS Gage, South Royalston to Erving Paper Company, Erving. Miles 25.6-8.1	Dec-99	5
Millers River (3522150)	MA35-05_2002	Erving Paper Company, Erving to confluence with Connecticut River, Erving. Miles 8.1-0.0	Dec-99	5

[49] Table adapted from www.mass.gov/dep/brp/wm/tmdls.htm

NAME	SEGMENT ID	DESCRIPTION	ASSESSMENT DATE	CATEGORY
Minott Pond (35046)	MA35046_2002	Westminster	Feb-97	3
Minott Pond South (35045)	MA35045_2002	Westminster	Feb-97	3
Lake Monomonac (35047)	MA35047_2002	MA portion only. Winchendon/Rindge,N.H.	Feb-97	4c
Moores Pond (35048)	MA35048_2002	Warwick	Feb-97	3
Mormon Hollow Brook (3522225)	MA35-15_2002	Headwaters just north of Montague Rd, Wendell to confluence with Millers River, Wendell. Miles	Jul-97	3
North Spectacle Pond (35052)	MA35052_2002	New Salem	Feb-97	2
Otter River (3523800)	MA35-06_2002	Source, Hubbardston (north of Pitcherville Road) to Gardner WWTP, Gardner. Miles 12.2-9.6	Sep-97	2
Otter River (3523800)	MA35-07_2002	Gardner WWTP to Seaman Paper Dam, Templeton. Miles 9.6-5.6	Sep-97	5
Otter River (3523800)	MA35-08_2002	Seaman Paper Dam, Templeton to confluence with Millers River, Winchendon. Miles 5.6-0.0	Sep-97	5
Packard Pond (35053)	MA35053_2002	Orange	Feb-97	2
Parker Pond (35056)	MA35056_2002	Gardner	Feb-97	4c
Partridgeville Pond (35057)	MA35057_2002	Templeton	Feb-97	2
Perley Brook Reservoir (35059)	MA35059_2002	Gardner	Feb-97	2
Phillipston Reservoir (35060)	MA35060_2002	Philipston/Athol	Feb-97	2
Priest Brook (3524150)	MA35-10_2002	Headwaters at the confluence of Towne and Scott Brooks, Royalston to the confluence with the Millers	Sep-97	5
Ramsdall Pond (35062)	MA35062_2002	Gardner	Feb-97	3
Reservoir No. 1 (35063)	MA35063_2002	Athol	Feb-97	3
Reservoir No. 2 (35064)	MA35064_2002	Lake) Philipston/Athol	Feb-97	3
Riceville Pond (35065)	MA35065_2002	Athol/Petersham	Feb-97	3
Richards Reservoir (35067)	MA35067_2002	Warwick	Feb-97	3
Lake Rohunta (35070)	MA35070_2002	(Basin) Athol/Orange/New Salem	Feb-97	5
Lake Rohunta (35106)	MA35106_2002	(Basin) Athol/Orange	Feb-97	5
Lake Rohunta (35107)	MA35107_2002	(Basin) New Salem	Feb-97	5
Royalston Road Pond (35071)	MA35071_2002	Orange	Feb-97	3
Ruggles Pond (35072)	MA35072_2002	Wendell	Feb-97	3
Sheomet Lake (35074)	MA35074_2002	Warwick	Feb-97	2
South Athol Pond (35078)	MA35078_2002	Athol	Feb-97	4c
South Spectacle Pond (35081)	MA35081_2002	New Salem	Feb-97	3
Sportsmans Pond (35082)	MA35082_2002	Athol	Feb-97	3
Stoddard Pond (35083)	MA35083_2002	Winchendon	Feb-97	3
Sunset Lake (35086)	MA35086_2002	Ashburnham/Winchendon	Sep-96	3
Tully Lake (35111)	MA35111_2002	Royalston	Feb-97	2
Tully Pond (35089)	MA35089_2002	Orange	Feb-97	3
Tully River (3523150)	MA35-14_2002	Confluence East and West Branches Tully River, Orange/Athol to confluence with Millers River, Athol.	Sep-97	5
Upper Naukeag Lake (35090)	MA35090_2002	Ashburnham	Feb-97	5
Upper Reservoir (35091)	MA35091_2002	Westminster	Feb-97	5
Wallace Pond (35092)	MA35092_2002	Ashburnham	Feb-97	3
Ward Pond (35093)	MA35093_2002	Athol	Feb-97	3
Lake Watatic (35095)	MA35095_2002	Ashburnham	Dec-91	3
NAME	SEGMENT ID	DESCRIPTION	ASSESSMENT DATE	CATEGORY

West Branch Tully River (3523175)	MA35-11_2002	Outlet Sheomet Lake, Warwick to confluence with East Branch Tully River forming headwaters Tully River, Orange/Athol. Miles 6.2-0.0	Sep-97	5
Wheelers Pond (35097) Whetstone Brook (3522450) MA35-18_2002	MA35097_2002	Warwick Headwaters northeast of Orcutt Hill near New Salem Rd, Wendell to confluence with Millers River, Wendell. Miles 5.0-0.0	Feb-97 Sep-97	3 3
White Pond (35098)	MA35098_2002	Athol	Feb-97	4c
Whites Mill Pond (35099)	MA35099_2002	Winchendon	Feb-97	3
Whitney Pond (35101)	MA35101_2002	Winchendon	Feb-97	5
Wickett Pond (35102)	MA35102_2002	Wendell	Feb-97	2
Wrights Reservoir (35104)	MA35104_2002	Gardner/Westminster	Feb-97	3

Summary of Fishery Conditions by Subwatershed[50]

As described earlier, the Millers River watershed includes fourteen (14) major subwatersheds. Within these subwatersheds, the major tributaries and the mainstem of the Millers River have been divided into "river segments" by the MA DEP (see Figure 2-1). In the following section, brief, summary descriptions of the fisheries and aquatic habitat are provided, if available, for each of the river segments within these subwatersheds that have been assessed by the MA DEP. These segment descriptions have been excerpted from the Millers River Watershed 2000 Water Quality Assessment Report issued by the MA DEP. For detailed information regarding the *Aquatic Life Use* for each segment, please refer to the Millers River Watershed 2000 Water Quality Assessment Report.

Upper Millers River Subwatershed

MA 35-20

This segment of the Millers River begins at the outlet of Sunset Lake in Ashburnham and ends at the inlet to Whitney Pond in Winchendon. Fallfish, a fluvial specialist, dominated the fish samples collected; however, more than half of the species present were macrohabitat generalists. Two species, which represented 64% of the fish sample, are fluvial specialist or dependant species that require flowing water during all or part of their life cycle. All of the fish species present are tolerant/moderately tolerant of pollution.

As only limited data are available, the *Aquatic Life Use* is **Not Assessed** for this segment of the Millers River. However, this use is identified with an ***Alert Status*** because of water withdrawals (both Ashburnham and Winchendon exceeded their Water Management Act registrations, some water is transferred to the Nashua River Watershed, the return flow from the Ashburnham sewers go to the Gardner Wastewater Treatment Plant and to the Otter River subwatershed and the return flow from the Winchendon Water Pollution Control Facility discharge is downstream from this segment), and dam operations that may affect instream habitat/flow.

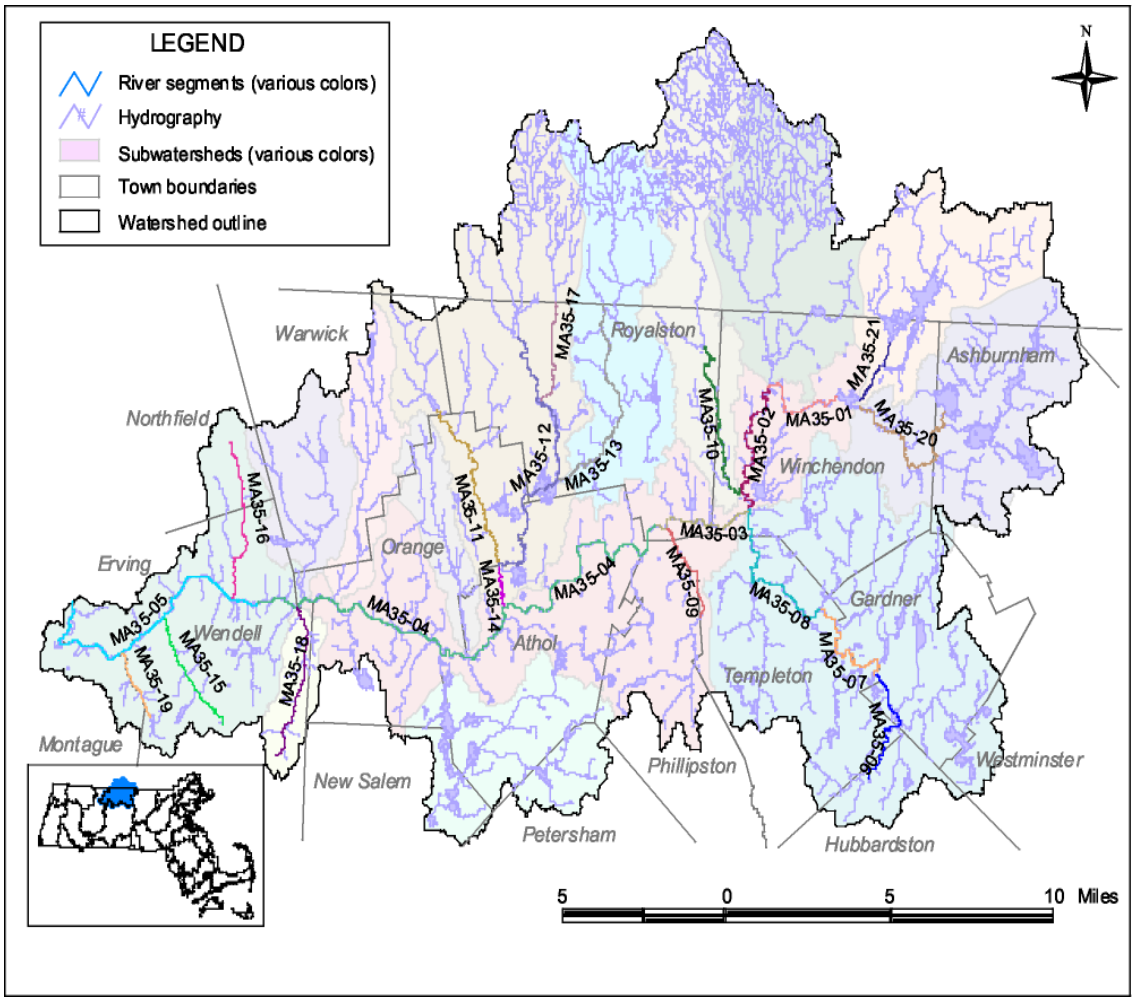
Middle Millers River Subwatershed

Segment 35-01

This segment of the Millers River begins at the outlet of Whitney Pond in Winchendon then flows in a generally west-southwesterly direction for a little over a mile before turning north for about a half mile. As the river turns almost 180° to the south, it is joined by Tarbell Brook. The segment ends at the Winchendon Water Pollution Control Facility discharge. The *Aquatic Life Use* is assessed as **Impaired** for this segment because of frequently poor survival of test organisms exposed to river water. The source of toxicity is unknown at this time. Flow alteration (pulsing flows) recorded at USGS gages are also a concern.

[50] Kennedy and Rojko, op.cit.

Figure 2-1
Millers River Watershed – River Segment Locations Identified by Segment Number[51]



[51] Figure courtesy of Kennedy and Rojko, op.cit.

Segment MA35-02

From its beginning at the Winchendon Water Pollution Control Facility this segment meanders essentially to the south, receiving the flow from Priest Brook, and ends at the confluence with the Otter River in Winchendon. The US Army Corps of Engineers maintains a dry-bed reservoir flood control project, Birch Hill Dam, in the town of Royalston which can impound water throughout this segment of the Millers River.

Although three fluvial specialists/dependant species dominated the fish samples collected from this segment, all are classified as tolerant or moderately tolerant of degraded water or habitat quality. A number of macrohabitat generalist species were also present but in very low numbers.

Two fish, a 5-year old white sucker and a 7-year old chain pickerel, were collected from this segment of the Millers River (just upstream of its confluence with the Otter River) in September 1999. The total PCB concentration in the white sucker "whole fish" sample was 959 parts per billion (ppb) wet weight and the chain pickerel "whole fish" sample was 6,949 ppb wet weight. These levels of total PCBs in whole fish both exceeded (by a factor of 1.9 and 13.9 times, respectively) the National Academy of Sciences/National Academy of Engineers (NAS/NAE) guideline for total PCBs of 500 ppb wet weight for the protection of fish-eating wildlife.

The *Aquatic Life Use* is assessed as **Impaired** because of the elevated PCBs in 'whole fish' that exceeded the NAS/NAE guidelines. The current source of PCBs in river water is contaminated sediments in the Otter and Millers Rivers. The original source of sediment contamination is believed to be located near the former Baldwinville Products Mill (property currently owned by American Tissue Mills, Inc.) and the Templeton WWTP and probably is related to historic discharge from the former Baldwinville Products Mill to the Otter River.

Segment 35-03

From the confluence with the Otter River in Winchendon, this segment of the Millers River continues to meander westerly to the USGS gage station in South Royalston. The Army Corps of Engineers maintains a dry-bed reservoir flood control project, Birch Hill Dam, in the town of Royalston within this segment of the Millers River.

Sediments in this segment of the Millers River are contaminated with PCBs. The concentrations of total PCBs in surficial sediment ranged from 4 to 49 ppm upstream of the Birch Hill Dam and were lower (<0.1 ppm to 0.5 ppm) in surficial sediment downstream from the Dam. The highest concentrations of PCBs, however, were detected in deeper sediment samples (12 to 14 inches below the sediment/water interface) upstream of the Birch Hill Dam where the maximum concentration was 180 ppm.

The total PCB concentrations in surficial sediment screening samples collected in July 1999 and the focused surficial sediment screening samples collected in August 1999 from 21 stations along this segment of the Millers River ranged from <2 to 25 ppm.

A total of eight fish were collected from this segment of the Millers River in September and October 1999. Four fish, including a 5 and a 6-year old chain pickerel, a 2-year old brown bullhead and a 4- year old yellow perch were collected from this segment of the Millers River upstream of the Birch Hill Dam. Four fish, including two 3-year old chain pickerels, an 8-year old yellow perch and a 6-year old white sucker were collected from the river downstream from the Birch Hill Dam. The total PCB concentrations in the "whole fish" samples of fish collected from the Millers River upstream of the Birch Hill Dam ranged from 1707 to 18,371 ppb wet weight. These levels of total PCBs in whole fish all exceeded (3.4 to 37 times) the NAS/NAE guideline for total PCBs of 500 ppb wet weight for the protection of fish-eating wildlife. The total PCB concentrations in the "whole fish" samples of the fish collected from the river downstream from Birch Hill Dam ranged from 3,989 to 12,467 ppb wet weight, exceeding the NAS/NAE guideline by factors of 8.0 to 25 times.

Because of PCB contamination in sediment and whole fish, the *Aquatic Life Use* is assessed as **Impaired**. The current source of PCBs in river water is contaminated sediments in the Otter and Millers Rivers. The original source of sediment contamination is believed to be located near the former Baldwinville Products Mill (property currently owned by American Tissue Mills, Inc.) and the Templeton WWTP and probably is related to historic discharge from the former Baldwinville Products Mill to the Otter River.

Segment MA35-04

From the USGS gage in South Royalston the Millers River flows west and west-southwest through Athol and then turns to flow west/northwest through Orange. The river then forms the border between Erving and Wendell. This segment ends at the Erving Center WWTP discharge (formerly the Erving Paper Company discharge).

In 2001, MA DFWELE (Massachusetts Department of Fisheries, Wildlife and Environmental Law Enforcement which is now the MA Department of Fish and Game) proposed that Gulf, Osgood, and West brooks, direct tributaries to this segment of the Millers River, and Ellinwood and Riceville brooks (in the Lake Rohunta subwatershed) be reclassified in the SWQS as Cold Water Fishery.

MA DFWELE conducted fish population sampling at several sites along the mainstem Millers River within this segment. On the mainstem Millers, near Fish Park in Athol, sampling was dominated by fluvial specialist/dependant species (white sucker and fallfish). In addition, with the presence of smallmouth bass and common shiner, the community is more consistent with that typically found in larger rivers.

At three other locations on the mainstem, fish samples were co-dominated by white sucker, a fluvial dependant species and macrohabitat generalists. The presence of warm-water macrohabitat generalists is typical of slow-moving or impounded waters. All fish collected were either tolerant or moderately tolerant to pollution. It appears that the impoundments located both upstream and downstream may be influencing the fish community at this location.

Sampling was conducted on the mainstem Millers, at the Lake Rohunta outlet stream in Orange, on August 18, 2000. A total of 98 fish were collected with the most dominant species being white sucker (*Catostomus commersoni*). Other species present included: yellow perch (*Perca flavescens*), largemouth bass (*Micropterus salmoides*), golden shiner (*Notemigonus crysoleucas*), creek chubsucker (*Erimyzon oblongus*), chain pickerel (*Esox niger*) and pumpkinseed (*Lepomis gibbosus*). The presence of creek chubsucker at this location is noteworthy. This species is a fluvial specialist and is either moderately tolerant or intolerant to pollution.

On August 18, 2000, sampling was conducted on the mainstem Millers, north of the boat ramp in Orange. A total of 88 fish were collected with the most dominant species being pumpkinseed (*Lepomis gibbosus*). Other species present, in order of abundance, included: chain pickerel (*Esox niger*), largemouth bass (*Micropterus salmoides*), yellow perch (*Perca flavescens*), bluegill (*Lepomis macrochirus*), and white sucker (*Catostomus commersoni*). Sampling was also conducted by the Division of Watershed Management (DWM) as part of the fish toxics monitoring survey in 2000. In addition to the species observed by MA DFWELE, DWM also noted the presence of black crappie, pumpkinseed, and American eel. The dominance of warm-water macrohabitat generalist species is typical of impounded waters.

The *Aquatic Life Use* is assessed as **Support**. For the past several years, the state, with the aid of volunteers, has been stocking salmon fry in the Millers River from South Royalston to Athol.

Beaver Brook
Segment MA 35-09
Although this brook is actually formed by the confluence of the Chickerling and Dunn brooks in Phillipston, this segment begins at the outfall of the Templeton Developmental Center (formerly the Fernald School) WWTP discharge in Templeton. The brook flows rapidly in a north-northwesterly direction as it forms the boundary between Templeton and Phillipston. As it passes under Royalston Road it slows and enters an extensive wetland area before joining the Millers River in South Royalston.

Fish collected in this segment were dominated by fluvial dependant/specialists and the presence of multiple age-classes of eastern brook trout is indicative of good water quality and stable flow regimes. Although the *Aquatic Life Use* is assessed as **Support**, MA DEP has given this use an ***Alert Status*** due to low pH and alkalinity as well as concerns about levels of other tested parameters.

Otter River Subwatershed

Segment MA35-06
The Otter River originates just north of Pitcherville Road in Hubbardston and meanders generally north through wetlands into Templeton. It receives the flow from Templeton Brook and flows near the southeastern edge of the Gardner Municipal Airport. It then picks up the flow from Hubbardston Brook and continues to flow north into an impounded area in

Gardner. Here it is joined by Pond Brook then flows under Routes 2 and 2A. The segment ends at the discharge from the Gardner WWTP.

MA DFWELE has proposed that Templeton Brook, a tributary to this segment of the Otter River, be reclassified in the SWQS as a Cold Water Fishery.

Fish population sampling was conducted by MA DFWELE in the Otter River near the airport access in Templeton on August 4, 2000. In the first round of sampling, a total of 54 fish represented by 9 species were present. Fish species, in order of abundance, included the following: brown bullhead (*Ameiurus nebulosus*), yellow perch (*Perca flavescens*), white sucker (*Catostomus commersoni*), creek chubsucker (*Erimyzon oblongus*), pumpkinseed (*Lepomis gibbosus*), golden shiner (*Notemigonus crysoleucas*), chain pickerel (*Esox niger*), yellow bullhead (*Ameiurus natalis*) and largemouth bass (*Micropterus salmoides*). A second round of sampling yielded a total of 248 fish represented by 12 species were present with white sucker (*Catostomus commersoni*) being the most common. Other species, in order of abundance, were the following: golden shiner (*Notemigonus crysoleucas*), yellow perch (*Perca flavescens*), pumpkinseed (*Lepomis gibbosus*), creek chubsucker (*Erimyzon oblongus*), brown bullhead (*Ameiurus nebulosus*), largemouth bass (*Micropterus salmoides*), black crappie (*Promoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), American eel (*Anguilla rostrata*), and rainbow trout (*Oncorhynchus mykiss*).

Although the fish species collected were almost all macrohabitat generalists, as expected given the low gradient nature of the reach sampled, white sucker, a fluvial dependant species which is tolerant of low dissolved oxygen (DO) and elevated temperatures, dominated the sample. In contrast, the presence of creek chubsucker, an intolerant fluvial specialist, is indicative of good habitat quality. The *Aquatic Life Use* is **Not Assessed** due to lack of current data. However, this segment has been flagged with an ***Alert Status*** due to low DO and elevated temperatures.

Segment MA35-07

This segment begins at the Gardner WWTP outfall and forms the boundary between Gardner and Templeton as it flows past several large sand and gravel operations. Immediately downstream from the USGS gage at Turner Street the river enters Templeton proper, and flows into the impoundment behind the Seaman Paper Company dam, which marks the end of the reach.

MA DFWELE has proposed that Bailey and Wilder brooks, tributaries in this subwatershed of the Otter River, be reclassified in the SWQS as Cold Water Fishery.

On October 18, 1996, the fish population sampling conducted in this reach of the Otter River upstream from Turner/Bridge Streets in Templeton/Gardner yielded six species, including, in order of abundance, fallfish *(Semotilus corporalis*), white sucker (*Catostomus commersoni*), pumpkinseed (*Lepomis gibbosus*) and a single individual each of yellow perch (*Perca flavescens),* longnose dace (*Rhinichthys cataractae*), and brook trout (*Salvelinus fontinalis*). Both fallfish and white suckers are fluvial dependant/specialist species which are both

tolerant to pollution. Although two intolerant species were present (brown trout and longnose dace), only one individual of each were collected.

On August 24, 2000, MA DFWELE sampled east and west of Hamlet Mill Road in Templeton. A total of 56 fish were collected and over 50% of the population was composed of white sucker (*Catostomus commersoni*). Other species present included: pumpkinseed (*Lepomis gibbosus*), brown trout (*Salmo trutta*), chain pickerel (*Esox niger*), golden shiner (*Notemigonus crysoleucas*), largemouth bass (*Micropterus salmoides*), tesselated darter (*Etheostoma olmstedi*), yellow perch (*Perca flavescens*), fallfish (*Semotilus corporalis*), brown bullhead (*Ameiurus nebulosus*), American eel (*Anguilla rostrata*), and longnose dace (*Rhinicthys cataractae*). Although 12 species were present the sample was dominated by white sucker, and six species (four of which are fluvial specialists/dependants), were represented by only one individual each. White suckers are a fluvial dependant species which are tolerant of many types of environmental stressors including low DO, high temperature and habitat degradation. The *Aquatic Life Use* is assessed as **Impaired**.

Segment MA35-08

From the Seaman Paper Company dam the river flows through a short section of rapids before slowing again and entering the impoundment formed by the partially-breached dam at the old Baldwinville Products Mill. Just downstream from here the river receives effluent from the Templeton WWTP. From here the river flows more rapidly through the Village of Baldwinville, but slows again downstream in a wetland area of Otter River State Forest. As the Otter River meanders northward toward the end of the segment at its confluence with the Millers River in Winchendon, it is joined by Trout Brook.

In 2001, MA DFWELE proposed that Norcross Hill Brook, a tributary to this segment of the Otter River, be reclassified in the SWQS as a Cold Water Fishery.

MA DFWELE conducted fish population sampling in the Otter River east of Route 202 in Templeton on August 23, 2000. The predominant species was white sucker (*Catostomus commersoni*) followed by fallfish (*Semotilus corporalis*) and common shiner (*Notropis cornutus*). Other fish species present included: yellow perch (*Perca flavescens*), longnose dace (*Rhinicthys cataractae*), pumpkinseed (*Lepomis gibbosus*), chain pickerel (*Esox niger*), golden shiner (*Notemigonus crysoleucas*), largemouth bass (*Micropterus salmoides*), yellow bullhead (*Ameiurus natalis*), and brown bullhead (*Ameiurus nebulosus*). The fish assemblage was dominated by four fluvial species that comprised 90% of the sample; however, all are either tolerant or moderately tolerant to pollution. The absence of intolerant species is indicative of environmental degradation. White sucker, the most abundant fish present, are extremely tolerant of low DO, elevated temperature and habitat degradation (e.g., sedimentation).

Another Otter River site sampled on that same date was located upstream from Trout Brook in Templeton. The population was dominated by macrohabitat generalists including pumpkinseed (*Lepomis gibbosus*) and bluegill (*Lepomis macrochirus*). Other species present included: white sucker (*Catostomus commersoni*), yellow perch (*Perca flavescens*), fallfish (*Semotilus corporalis*), chain pickerel (*Esox niger*), largemouth bass (*Micropterus*

salmoides), tesselated darter (*Etheostoma olmstedi*), yellow bullhead (*Ameiurus natalis*), common shiner (*Notropis cornutus*) and brown bullhead (*Ameiurus nebulosus*).

The presence of large numbers of pumpkinseed, bluegill and yellow perch are typical of low gradient, silty, wetlands-dominated streams. Although there were four species present which are considered fluvial dependent/specialists, three of these species were represented by only twenty individuals (less than 6% of the total collected). The most dominant of the fluvial dependent/specialists was white sucker, which is tolerant of environmental degradation.

Total PCB concentrations in surficial sediment screening samples collected in July and August 1999 from 50 stations along this segment of the Otter River ranged from < 2 ppm to >25 ppm. In the vicinity of the Seaman Paper Company Dam, total PCB concentrations were <2ppm. Here the river has a generally rocky bottom. Further downstream in the vicinity of Baldwinville, the Otter River is wider with a soft, sandy bottom. In this area, four of 12 screening samples had PCB concentrations between 2 and 25 ppm (downstream from the Templeton WWTP discharge), the other eight samples were <2ppm. Continuing downstream, the Otter River meanders through a floodplain and is characterized by a soft, silty bottom. In this section of the river, five of six surficial sediment screening samples had >25 ppm total PCBs. In the most downstream reach where the river is characterized with a sandy/rocky bottom, total PCB concentrations ranged between 2 and 25 ppm.

Sediments in this segment of the Otter River, particularly downstream from the Templeton WWTP discharge, are contaminated with PCBs. The highest concentration of PCBs was detected in a 14" deep subsurface sample (250 ppm) taken from this segment of the Otter River.

A total of seven fish were collected from this segment of the Otter River in September 1999 through the Army Corp of Engineers site assessment and risk characterization study. These included a 3 and a 4-year old chain pickerel, two 2-year old brown bullheads, a 5-year old yellow perch, a 5-year old largemouth bass, and a 5-year old white sucker. The total PCB concentrations in the "whole fish" samples of these fish collected ranged from 341 to 18,922 ppb wet weight. Six of the seven "whole fish" had levels of total PCBs that exceeded (4.1 to 38 times) the NAS/NAE guideline for total PCBs of 500 ppb wet weight for the protection of fish-eating wildlife.

The *Aquatic Life Use* is assessed as **Impaired** for this segment of the Otter River because of PCB contamination in sediment and whole fish, the biological monitoring data and best professional judgment. Although the benthic macroinvertebrate community was only slightly impacted in the 2000 survey, it was the opinion of the biologists that stress to aquatic life inhabiting this segment of the Otter River is still likely under low-flow conditions. The fish community was also dominated by species tolerant of many types of environmental stressors including low DO, high temperature and habitat degradation. Additionally, chronic toxicity was occasionally detected the Seaman Paper Company WWTP discharge and elevated total phosphorus concentrations in the Otter River were documented. The current source of PCBs in river water is contaminated sediments in the Otter and Millers Rivers. The original source of sediment contamination is believed to be located near the former

Baldwinville Products Mill (property currently owned by American Tissue Mills, Inc.) and the Templeton WWTP and probably is related to historic discharge from the former Baldwinville Products Mill to the Otter River. This segment of the Otter River has been identified at a medium stress level based on water quantity and has experienced flow fluctuations which is also of concern.

Tully River Subwatershed

Segment MA35-12

The East Branch Tully River is formed by the confluence of Tully Brook and Falls Brook in Royalston State Forest. It flows southwestward for approximately three miles before entering Long Pond, and then continues south to Tully Lake. Tully Lake was formed by Tully Dam, built and operated by the US Army Corps of Engineers. From the dam the river flows south and then west, forming the boundary between Orange and Athol for most of the distance, to its confluence with the West Branch in Athol Center. The Army Corps of Engineers maintains a flood control project, Tully Lake, in the town of Royalston within this segment of the East Branch Tully River.

In 2001, MA DFWELE proposed that the East Branch Tully River and Tully Brook, a tributary to this segment of the East Branch Tully River, be reclassified in the SWQS as Cold Water Fisheries.

MA DFWELE conducted fish population sampling in the East Branch Tully River south of Route 68 on July 10, 2000. A total of 16 fish were collected. Fish species present, in order of abundance, included: yellow perch (*Perca flavescens*), chain pickerel (*Esox niger*), white sucker (*Catostomus commersoni*), creek chubsucker (*Erimyzon oblongus*) and one brook trout (*Salvelinus fontinalis*). The fish community was dominated by two macrohabitat generalists and the total numbers of fish were very low. It is unclear whether these macrohabitat generalists are resident or have migrated from Long Pond (located downstream from this sampling reach). The river is bordered by wetlands which suggests a low stream gradient.

On October 18, 1996, fish population samples were collected by the DEP DWM biologists from East Branch Tully River upstream from Tully Road/Pinedale Avenue, Athol/Orange. The fish population from this section of the East Branch Tully River was comprised of 10 species including, in order of abundance, longnose dace (*Rhinichthys cataractae*), tessellated darter (*Etheostoma olmstedi*), fallfish (*Semotilus corporalis*) and brown trout (*Salmo trutta*), blacknose dace (*Rhinichthys atratulus*) and white sucker (*Catostomus commersoni*), and an individual each of yellow bullhead (*Ameiurus natalis*), common shiner (*Luxilus cornutus*), chain pickerel (*Esox niger*) and one brook trout (*Salvelinus fontinalis*).

It was noted that four of the 11 longnose dace had tumors. In addition two brown trout were noted as having deformed pectoral fins; however, these types of deformities are common with hatchery fish. This community was comprised primarily of fluvial species; however, their numbers were very low. The presence of three intolerant species suggests excellent water quality. Although the *Aquatic Life Use* is assessed as **Support**, is does have an ***Alert Status*** due to the low numbers of fish.

Segment MA35-17

Boyce Brook comprises this small segment which begins at the New Hampshire state line and flows south to the confluence with the East Branch Tully River. MA DFWELE has proposed that Boyce Brook be reclassified in the SWQS as a Cold Water Fishery.

The fish population in Boyce Brook was sampled on October 2, 1996 and September 21, 2000 and was comprised of only of brook trout (*Salvelinus fontinalis*). A total of 29 fish (multiple age classes) were collected in 2000. The presence of multiple age classes of brook trout is indicative of excellent water quality and is consistent with conditions typically found in the headwaters of cold-water streams. The *Aquatic Life Use* is assessed as **Support** based primarily on the fish population information. Although only brook trout were present, this can be typical in headwaters of cold-water streams.

Segment MA35-11

The West Branch Tully River originates in Warwick, MA at the outlet of Sheomet Lake which is, itself, fed by Tully Brook. The river flows rapidly southeastward to Tully Meadow where it is joined by Collar Brook. From here the river flows more southerly while slowly passing through a wetland area just west of Tully Mountain. Downstream, the West Branch and East Branch Tully Rivers conjoin at the Orange-Athol corporate boundary. This segment is assessed as **Support** for the *Aquatic Life Use.*

Collar Brook which is a tributary to the West Branch Tully River was sampled for fish population by MA DFWELE on July 10, 2000. The dominant species found were blacknose dace (*Rhinichthys atratulus*) and brook trout (*Salvelinus fontinalis*) with a smaller population of slimy sculpin (*Cottus cognatus*). In 2001, MA DFWELE proposed that the West Branch Tully River as well as three of its tributaries, Collar, Fish and Tully brooks, be reclassified in the SWQS as Cold Water Fisheries.

Fish population sampling was conducted on October 2, 1996 from the West Branch Tully River upstream of Flagg Road in Orange. The fish population in the river at this location was comprised of 14 fish represented by six species including, in order of abundance, blacknose dace (*Rhinichthys atratulus*), brown trout (*Salmo trutta*), brown bullhead (*Ameiurus nebulosus*) and longnose dace (*Rhinichthys cataractae*), and an individual chain pickerel (*Esox niger*) and white sucker (*Catostomus commersoni*). Four of these species were fluvial specialists/dependants and two were intolerant (one of which were likely stocked fish). It should be noted that the fish numbers were low; however, it is unclear whether this was due to slightly colored water and/or leaf fall.

MA DFWELE sampled fish populations in the West Branch Tully River on July 10, 2000 and August 30, 2000. The most dominant species was longnose dace (*Rhinicthys cataractae*) (an intolerant fluvial specialist) with blacknose dace (*Rhinichthys atratulus*) as the next most prevalent species. Other species in lesser amounts were brook trout (*Salvelinus fontinalis*), tesselated darter (*Etheostoma olmstedi*), yellow perch (*Perca flavescens*), golden shiner (*Notemigonus crysoleucas*), pumpkinseed (*Lepomis gibbosus*), and white sucker (*Catostomus commersoni*). The abundance of fluvial species is indicative of excellent water quality and

stable flow regimes, and although three macrohabitat generalist species were collected, only five individuals were noted. During the August survey, sampling was conducted north of Tully Road in Orange. A total of 24 fish represented by 9 species were collected. Fish species present, in order of abundance, included: yellow perch (*Perca flavescens*), white sucker (*Catostomus commersoni*), fallfish (*Semotilus corporalis*), brook trout (*Salvelinus fontinalis*), chain pickerel (*Esox niger*), bluegill (*Lepomis macrochirus*), common shiner (*Notropis cornutus*), pumpkinseed (*Lepomis gibbosus*), and brown trout (*Salmo trutta*). The fish sample was a mix of macrohabitat generalist and fluvial species; however, the number of fish was very low. Whether or not this was due to poor sampling efficiency (reduced visibility and/or excessive depth) or some other water quality or habitat issue is undetermined.

Segment MA35-14

The Tully River begins at the confluence of its east and west branches at the Orange-Athol corporate boundary. From there it flows southward through a wetland for 1.5 miles before emptying into the Millers River, just north and west of the center of Athol. Several small tributaries join the Tully River along its course. The MA DEP determined that there is insufficient data so this segment was **Not Assessed** for the *Aquatic Life Use*.

MA DFWELE conducted fish population sampling in the Tully River near the Athol Conservation Area on August 30, 2000. A total of 53 fish represented by 10 species were collected. The most dominant species was white sucker (*Catostomus commersoni*). Other fish species present, in order of abundance, included: yellow perch (*Perca flavescens*), fallfish (*Semotilus corporalis*), chain pickerel (*Esox niger*), longnose dace (*Rhinicthys cataractae*), tesselated darter (*Etheostoma olmstedi*), yellow bullhead (*Ameiurus natalis*), brown trout (*Salmo trutta*), smallmouth bass (*Micropterus dolomieu*), and pumpkinseed (*Lepomis gibbosus*). The fish community was comprised of a mix of fluvial specialists/dependants and macrohabitat generalists. The fish assemblage in this reach appears to be influenced by its proximity to the mainstem Millers River. The slow moving section in the middle of this reach offers habitat for the generalist species present.

Lawrence Brook Subwatershed

Segment MA35-13

This segment begins at the MA-NH state line, although Lawrence Brook actually originates at the outlet of Sportsman Pond in Fitzwilliam, NH. Almost immediately downstream from the state line the brook enters a large wetland where it meanders southward, then to the west, and finally northward. As it finally flows in a southerly direction once again, it is joined by several small tributaries and the velocity increases with gradient. Just south of Northeast Fitzwilliam Road Lawrence Brook enters another wetland, where it flows slowly until it reaches Doane's Falls immediately west of Athol Road. Here the stream drops almost 150 feet before entering Tully Lake (East Branch Tully River).

During the fish population survey in Lawrence Brook conducted on October 18, 1996 the community was comprised, in order of abundance, of chain pickerel (*Esox niger*) and white sucker (*Catostomus commersoni*), brown bullhead (*Ameiurus nebulosus*), and an individual largemouth bass (*Micropterus salmoides*). The fish community was composed primarily of

macrohabitat generalists and one tolerant fluvial dependant species. The numbers of fish collected were very low (only 14 fish were collected) and atypical of the habitat present. It is unclear what is limiting the fish community in this stream reach. Because of the very low numbers of fish present in this stream, the *Aquatic Life Use* is assessed as **Support** but tagged with an ***Alert Status***.

Priest Brook Subwatershed

Segment MA 35-10
Priest Brook begins at the confluence of Scott and Towne brooks which, in turn, originate in Fitzwilliam, NH. Over the first mile, the brook flows through wetlands with occasional riffles. For the remainder of its length it alternates between riffles, pools, and wetland areas, as it flows south-southeast to the Millers River, west of Lake Dennison, in Templeton. Much of this subwatershed is protected in the Birch Hill State Wildlife Management Area.

MA DFWELE conducted fish population sampling in Scott Brook north of Templeton Turnpike Road in August 2000. A total of 137 fish represented by 8 species were collected. Fish species present, in order of abundance, included: fallfish (*Semotilus corporalis*), chain pickerel (*Esox niger*), white sucker (*Catostomus commersoni*), banded sunfish (*Enneacanthus obesus*), tesselated darter (*Etheostoma olmstedi*), pumpkinseed (*Lepomis gibbosus*), creek chubsucker (*Erimyzon oblongus*) and brown bullhead (*Ameiurus nebulosus*).

MA DFWELE conducted fish population sampling in Priest Brook near Birch Hill in August 2000. A total of 99 fish represented by 9 species were collected. Fish species present, in order of abundance, included: fallfish (*Semotilus corporalis*), chain pickerel (*Esox niger*), brown trout (*Salmo trutta*), brown bullhead (*Ameiurus nebulosus*), banded sunfish (*Enneacanthus obesus*), creek chubsucker (*Erimyzon oblongus*), yellow perch (*Perca flavescens*), tesselated darter (*Etheostoma olmstedi*), and white sucker (*Catostomus commersoni*). Fluvial specialists/dependant species dominated the fish sample although the brown trout were likely stocked. The presence of brown trout and creek chubsucker, both of which are intolerant to pollution, indicated good water quality conditions. The *Aquatic Life Use* is assessed as **Support** but there is an ***Alert Status*** attached because of the low pH.

North Branch Millers River Subwatershed

Segment MA 35-21
The North Branch Millers River begins at the outlet of Lake Monomonac in Winchendon. The river flows in a generally southwest direction, receiving the flow from one unnamed tributary draining White Mill Pond, and flows into Whitney Pond in Winchendon. The segment ends at the inlet to Whitney Pond. The MA DEP could not assess this segment due to the lack of data. The *Aquatic Life Use* is **Not Assessed** but flagged with an ***Alert Status*** due to influence of the dams on this segment.

MA DFWELE conducted fish population sampling in the North Branch Millers River, south of Maple Street on July 24, 2000. A total of 108 fish represented by 11 species were collected. The most dominant species was yellow perch (*Perca flavescens*). Other species present, in order of abundance, included: fallfish (*Semotilus corporalis*), white sucker

(*Catostomus commersoni*), redbreast sunfish (*Lepomis auritus*), brown bullhead (*Ameiurus nebulosus*), tesselated darter (*Etheostoma olmstedi*), largemouth bass (*Micropterus salmoides*), creek chubsucker (*Erimyzon oblongus*), banded sunfish (*Enneacanthus obesus*), bluegill (*Lepomis macrochirus*) and chain pickerel (*Esox niger*). Yellow perch, a macrohabitat generalist, dominated the fish sample, and more than half of the species present were macrohabitat generalists. Five species are fluvial specialist or dependant species which require flowing water during all or part of their life cycle, however they only represent 38% of the fish sample. Most of the fish species present are tolerant/moderately tolerant to pollution (exception is the creek chubsucker which is intolerant).

Lower Millers River Subwatershed

Mormon Hollow Brook Segment MA 35-15

The headwaters of Mormon Hollow Brook begin just north of Montague Road in Wendell and the brook flows in a northwesterly direction through Wendell until it empties into the Millers River. The MA DFWELE has proposed that Mormon Hollow Brook be reclassified as a Cold Water Fishery. Fish population surveys were conducted in Mormon Hollow Brook downstream from the confluence with Baker Brook near Farley Road in Wendell on September 27, 1996, September 21, 1998, and September 19, 2000. The samples were primarily comprised of multiple age classes of brook trout (*Salvelinus fontinalis*) which are intolerant, fluvial specialists. In 1998 a pumpkinseed and a brown trout were also captured. The presence of multiple age classes of brook trout is indicative of excellent water and habitat quality. The *Aquatic Life Use* was assessed as **Support**.

MA DFWELE also conducted fish population sampling in Mormon Hollow Brook at the Metacomet & Monadnock trail crossing in September 2000. A total of 12 fish represented by 3 species were collected. Fish species present, in order of abundance, included: brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*) and pumpkinseed (*Lepomis gibbosus*). Multiple age classes of brook and brown trout were present. The pumpkinseed likely originated from Wickett Pond (located upstream).

Lyons Brook Segment 35-19

The outlet of Ruggles Pond in Wendell forms the headwaters of Lyons Brook. The brook flows northwesterly to the confluence of the Millers River at the Montague/Wendell boundary. MA DFWELE has proposed that Lyons Brook be reclassified as a Cold Water Fishery. On September 19, 2000 fish population sampling was conducted by DWM staff at the mouth of the brook between the railroad bridge and the confluence with the Millers River. The fish population in Lyons Brook was comprised, in order of abundance, of longnose dace (*Rhinichthys cataractae)*; native brook trout (*Salvelinus fontinalis*); fallfish (*Semotilus corporalis*); and white sucker (*Catostomus commersoni*). The dominance of longnose dace *Rhinichthys cataractae***,** and the presence of multiple age classes of brook trout indicate excellent water quality. White sucker and fallfish *Semotilus corporalis* were also collected. All fish collected are examples of fluvial specialists or fluvial dependant species, which suggests that the flow regime is stable. The *Aquatic Life Use* was assessed as **Support**.

In August of 2001 MA DFWELE conducted fish population sampling in Lyons Brook near the outflow of Ruggles Pond. A total of 8 fish were collected all of which were brook trout (*Salvelinus fontinalis*). The presence of multiple age classes of brook trout is indicative of excellent water quality and is consistent with conditions typically found in the headwaters of cold-water streams.

Keyup Brook Segment MA 35-16

The headwaters of Keyup Brook are located in the Great Swamp in Northfield. The brook flows south to the confluence with the Millers River. MA DFWELE has proposed that Keyup Brook and its tributary, Jacks Brook, be reclassified as Cold Water Fisheries.

Fish population sampling was conducted by DWM in an upstream and downstream reach of Keyup Brook on 26 September 1996. The fish population in the upstream reach of Keyup Brook was comprised entirely of native brook trout while the downstream reach was comprised, in order of abundance of blacknose dace (*Rhinichthys atratulus*), longnose dace (*Rhinichthys cataractae*), *Salmo trutta* (brown trout), white sucker (*Catostomus commersoni*) and an individual brook trout (*Salvelinus fontinalis*). On September 19. 2000, fish population sampling was conducted in the brook upstream from the confluence with Jacks Brook and downstream from the first Laurel Lake Road crossing in Erving by DEP DWM biologists. Blacknose dace (*Rhinichthys atratulus)* dominated the fish sample, while brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*) and white sucker (*Catostomus commersoni*) were also present. All fish collected were fluvial specialists or fluvial dependant species. MA DFWELE also conducted fish population sampling in Keyup Brook in the vicinity of the intersection of Swamp Road with Laurel Lake Road in Erving on August 30, 2000. A total of 76 fish represented by 4 species were collected. Fish species present, in order of abundance, included: brook trout (*Salvelinus fontinalis*), pumpkinseed (*Lepomis gibbosus*), white sucker (*Catostomus commersoni*) and blacknose dace (*Rhinichthys atratulus*). The dominant species was brook trout (n = 71). The presence of multiple age classes of brook and brown trout is indicative of excellent water and habitat quality. The *Aquatic Life Use* was assessed as **Support** but due to the extremely low pH and erosion problems in this segment it has been tagged with an ***Alert Status***.

Segment MA 35-05

This segment begins at the Erving Center WWTP and flows in a westerly direction, forming the border between Erving and Wendell. As the river continues toward the Village of Millers Falls, velocity increases as it drops through twelve sets of rapids. The river slows after it passes through the village, turns due north, and enters the backwater from the Connecticut River south of the French King Bridge at Route 2 in Erving. There is no fish population sampling data available for this reach. The *Aquatic Life Use* was assessed as **Support** but with an ***Alert Status*** due to flow fluctuations and potential PCB contamination.

Whetstone Brook Subwatershed

Segment MA 35-18

Northeast of Orcutt Hill, near New Salem Road in Wendell, the headwaters of Whetstone Brook flow in a northerly direction to join the Millers River in Wendell. MA DFWELE

proposed that Whetstone Brook be reclassified in the SWQS as a Cold Water Fishery. Whetstone Brook was the location of an experimental liming project conducted by the MA DFWELE in the late 1980's and early 1990's. Monitoring was conducted four years prior to and three years following treatment of the brook with limestone. The density of brook trout was found to increase significantly during the limestone treatment.

The fish population in Whetstone Brook was sampled approximately 50 meters downstream from the Kentfield Road crossing in Wendell was comprised of multiple age classes of brook trout (*Salvelinus fontinalis*) and an individual brown trout (*Salmo trutta*) in 1996 and only *S. fontinalis* in 1998 and 2000 (sampling was conducted on September 27, 1996, September 21, 1998, and September 21, 2000). The total number of fish sampled in 1996 was 10, in 1998 the number was 15, and in 2000 16 fish were sampled. MA DFWELE also conducted fish population sampling in this same reach of Whetstone Brook on September 13, 2000. A total of 13 fish were collected which were all brook trout (*Salvelinus fontinalis*). Although the number of fish was low, the presence of multiple age classes of brook trout, an intolerant, fluvial specialist, indicated excellent habitat and water quality conditions.

The *Aquatic Life Use* is assessed as **Support** based primarily on the fish population information. The presence of multiple age classes of brook trout is indicative of excellent habitat and water quality. Furthermore, these fish are fluvial specialists, which suggest that the flow regime has not been compromised in this brook. However, the consistently low number of fish present may be indicative of environmental stress (suspected to be associated with low pH) and, therefore, this use is identified with an ***Alert Status***.

Vegetation[52]

The Millers River Watershed supports a wide variety of major habitat types, including coniferous and deciduous forests, grasslands, wetlands, and riparian vegetation. The watershed's rivers, wetlands, forests, meadows, and mountain ridges provide sustenance, mating grounds, and vegetated cover to the wildlife dwelling within. Since many species rely on a variety of habitat types during different periods of their life cycle, species diversity is greatest in areas where several habitat types occur in close proximity to one another. When habitats are of high quality and ample quantity, wildlife populations thrive.

There are several Wildlife Management Areas (WMA) within the watershed which are managed by the MA Department of Fish & Game, including:

- Birch Hill WMA 3,210 acres
- Millers River WMA 2,621 acres
- Wendell WMA 575 acres
- High Ridge WMA 2,049 acres
- Phillipston WMA 3,383 acres

[52] Information for this section was adapted from Montachusett Regional Planning Commission and the Franklin Regional Council of Governments, op.cit.

- Popple Camp WMA 1,160 acres
- Tully Mountain WMA 332 acres
- Orange WMA 280 acres
- Fish Brook WMA 110 acres
- Lawrence Brook WMA 357 acres

These lands support a diverse population of wildlife and vegetation such as moose, deer, otter, mink, muskrat, porcupine, fisher, fox, eastern coyote, and black bear. The return of beaver to the region has led to the creation of wetlands that provide excellent habitat for many species of transient and migratory bird life. The Millers River is an important flyway, providing a safe foraging and resting area for large numbers of migrating waterfowl, shore birds, and raptors including Red-shouldered and Broad-Winged Hawks, Ospreys, Great-Horned and Barred owls, and Bald Eagles. Other migrants include Canada Geese, several species of ducks, and Cormorants. Great Blue Heron have been observed along stretches of the Millers River and in the beaver pond complex near Thousand Acre Swamp. Other bird species observed soaring overhead include Upland Sandpiper, Virginia Rail, Northern Shrike, Goshawk, Northern Raven, Carolina Wren, Marsh Wren, and Common Redpoll.

Approximately 79% of the Millers River Watershed is covered by forest (1999 MacConnell Land Use Data). This abundance of forested landscape provides a rich variety of habitats for wildlife. However, across the state, the trend in forest type distribution is one of overall forest maturation, with a corresponding loss in early-successional forests such as abandoned fields, grasslands, and shrublands.[53] There are many species of birds that prefer early-successional habitats and with a loss of this type of habitat; the numbers of these species have been declining. Five of six birds commonly associated with grasslands exhibited dramatic declines.[54] Two of these species, the vesper sparrow and grasshopper sparrow, have been identified in the Millers River Watershed. The NHESP has classified these sparrows as threatened in Massachusetts. The American Bittern, an endangered marsh bird species in Massachusetts, has been identified in the Millers River Watershed.

Wetlands

The Millers River Watershed contains approximately 24,000 acres of wetlands.[55] Wetlands provide many functions that benefit people as well as animals and plants. Wetlands act as large "sponges", storing water from heavy precipitation events and then slowly releasing it. Wetlands trap sediment and organic matter and their vegetation can absorb nutrients, thus improving the quality of water. Development of lands surrounding wetlands can negatively impact their usefulness for water filtration and flood control. Since most of the wetlands in the watershed are found along streams or rivers, they function as natural filters for surface waters, groundwaters and aquifers. In addition, wetlands provide habitat for a variety of flora and fauna, including many species of special concern.

[53] Upland Habitat Management Program, Massachusetts Division of Fish & Wildlife, web page, www.state.ma.us/DFG/dfw/bdi/uplandintro.htm.
[54] Ibid.
[55] Mass GIS National Wetlands Inventory Data Layer.

Vernal Pools

Vernal pools are temporary wetlands which fill each year with water from precipitation, spring runoff, and rising groundwater. Most will then become completely dry as water evaporates and groundwater levels recede. This wet-dry cycle prevents fish from becoming established; however, vernal pool habitat is critically important to a variety of wildlife species including some amphibians that breed exclusively in vernal pools. Other organisms spend their entire life cycles confined to vernal pool habitat. Many other species of wildlife use vernal pools for breeding, feeding and other functions.

According to 2003 MassGIS data, there are 114 certified vernal pools in the Millers River Watershed. These vernal pools have been certified by the Natural Heritage and Endangered Species Program according to the "Guidelines for Certification of Vernal Pool Habitat" prepared by the Massachusetts Department of Fish & Wildlife. In many cases, certification means the vernal pool can be protected under the Massachusetts Wetlands Protection Act. There are other state regulations that recognize certified vernal pools and offer some level of protection, including those governing forest cutting practices and septic systems.

Table 2-12
Potential Vernal Pools by Subwatershed and Town

Subwatershed	TOWN	Total		Subwatershed	Town	Total
West Brook	Athol	4		Moss Brook	Erving	1
	Orange	7			Warwick	16
Gales Brook	Orange	1		North Branch Millers River	Ashburnham	8
	Warwick	17			Winchendon	3
Lake Rohunta	Athol	16		Otter River	Ashburnham Gardner	1 34
	New Salem	10			Hubbardston	11
	Orange	7			Templeton	51
	Petersham	12			Westminster	5
					Winchendon	33
Lawrence Brook	Athol	1		Scott/Priest Brook	Royalston	20
	Royalston	38			Winchendon	13
Lower Millers River	Erving	18		Tarbell Brook	Winchendon	9
	Montague	8		Tully River	Athol	13
	Northfield	7			Orange	16
	Wendell	23			Royalston	36
Middle Millers River	Athol	31			Warwick	13
	Orange	28		Upper Millers River	Ashburnham	50
	Phillipston	18			Winchendon	10
	Royalston	7		West Brook	Athol Orange Warwick	4 12 3
	Templeton	5		Whetstone Brook	Orange	2
	Wendell	1			Wendell	1
	Winchendon	43				

There are over 650 potential vernal pools in the Millers River Watershed which have been mapped by NHESP using aerial photograph interpretation techniques. Not all potential vernal pools have been mapped due to limitations inherent in the interpretation of aerial photographs and the fact that these photographs represent a "snapshot" of time. Vernal pools can occur in a wide variety of different landscapes, including forested swamps, bogs and other wetlands. In order for a vernal pool to be officially certified, specific information must be collected in the field and then presented to the NHESP. The NHESP depends on volunteers to do the necessary field work to gather information for certifying potential vernal pools. The NHESP and other organizations provide guidelines and advice for certifying vernal pools that landowners, student groups and other interested citizens can use if they are interested in documenting vernal pools in their communities. It is important to remember that although many potential vernal pools have been identified and mapped, they are not protected under any state or federal regulations until they have been certified by NHESP.

Rare Species and Natural Communities, Millers River Watershed[56]

According to the Massachusetts Natural Heritage and Endangered Species Program, the rare species of the Millers River watershed are closely associated with the Millers and its tributaries, as well as with other wetland habitats in the area, such as vernal pools. This strong reliance on the habitat found along the mainstem of the Millers and its tributaries is somewhat unique among the many other watersheds in the state. Thirty-eight (38) state-listed rare species have been documented in the watershed, according to Natural Heritage records (see the table below). About 25 of these are dependent on, or closely associated with, wetlands at some point in their life cycle.

Rare animals in the watershed range from the Endangered American Bittern, found in marshes, to the Threatened Grasshopper and Vesper Sparrows, found in large grasslands, to the Special Concern Brook Snaketail dragonfly, which lives in clear, sandy-bottomed streams. Most (29 of 38) of the rare species in the watershed are animals. Protecting rare animals often involves protecting large tracts of land, where several interconnected populations of the animal can breed successfully over many years. For example, Wood Turtles live along slow-moving streams, spending some of their time in the water and some in the adjacent uplands, mostly within about 300 meters on either side of the stream. Their home range is about 3 to 5 hectares, which means that an individual Wood Turtle travels a considerable distance along a stream in the course of its activities. The greatest threats to Wood Turtles are roads, on which turtles are killed by vehicles as the turtles move along a stream or to upland nesting sites, and nest predators, such as raccoons and skunks, which tend to live in greater numbers around human dwellings. Thus, to protect a population of Wood Turtles, long, uninterrupted sections of streams and adjacent uplands must be protected. The best and most accessible indicators of the areas needed for viable populations of terrestrial and most wetland rare species are the Core Habitats of the BioMap recently produced by the Natural Heritage & Endangered Species Program.

[56] Text and tables for this section were prepared by the Massachusetts Natural Heritage & Endangered Species Program, May 7, 2003.

For aquatic species, the equivalent areas are the Core Habitats of the Living Waters map also produced by the Natural Heritage Program. The goal of the Living Waters Program is to promote the protection of freshwater biodiversity in Massachusetts. Habitat for freshwater species is vulnerable to degradation from water flow manipulations (such as those caused by dams and wastewater treatment plant operations), loss of riparian vegetation, and changes in water quality. The Natural Heritage Program has identified the most critical areas for freshwater species habitat preservation. These areas include Core Habitats such as lakes, ponds, rivers and streams and the associated Critical Supporting Watershed areas.

Table 2-13

Living Waters Core Habitat Species[57]

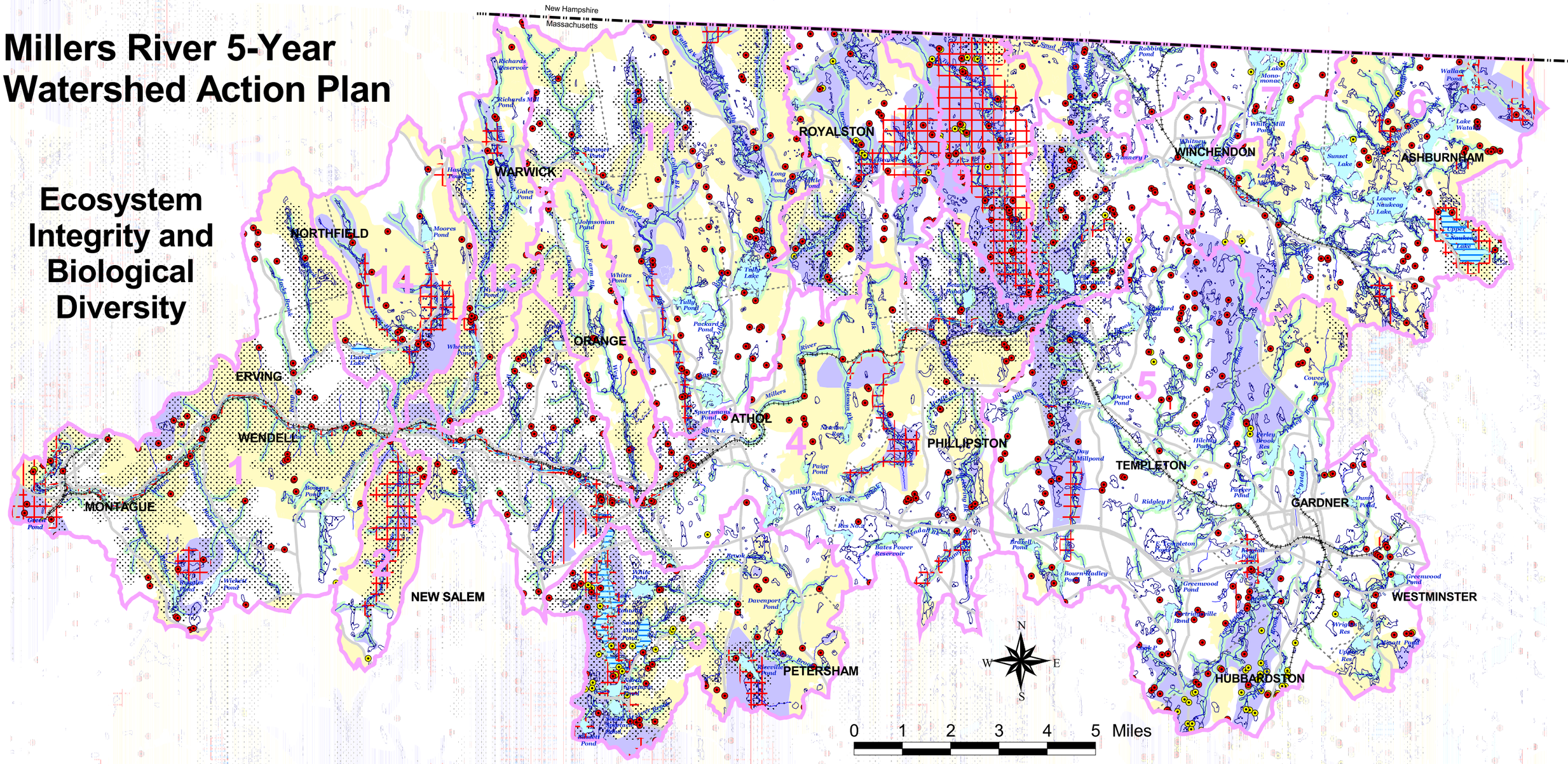
Reason for Delineating Core Habitat	State Status
Aquatic Insect Community	---
Pond Habitat	---
Bridle Shiner	Special Concern
Fish Community	---
Lake Habitat	---
Intricate Fairy Shrimp	Special Concern
Creeper	Special Concern
Triangle Floater	Special Concern
Algae-like Pondweed	Proposed Threatened

The rare plants of the Millers River watershed range from those of specialized habitats, such as the Pod-grass and Dwarf Mistletoe found in bogs, to plants of open habitats, such as Sand Violet and New England Blazing Star, to the Giant St. John's-Wort found in wet meadows. Protecting these species involves protecting their particular habitats from development or other threats, such as changes in water quality or quantity, or succession to dense forests.

[57] Prepared by the Massachusetts Natural Heritage & Endangered Species Program, March 15, 2004.

Millers River 5-Year Watershed Action Plan

Ecosystem Integrity and Biological Diversity



FRANKLIN REGIONAL COUNCIL OF GOVERNMENTS
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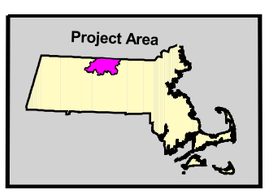

Sub-basin	Number	Sub-basin	Number
Lower Millers	1	Tarbell Brook	8
Whetstone Brook	2	Priest Brook	9
Lake Rohunta	3	Lawrence Brook	10
Middle Millers River	4	Tully River	11
Otter River	5	West Brook	12
Upper Millers River	6	Gales Brook	13
North Branch Millers	7	Moss Brook	14

Map Sources:

Map produced by The Franklin Regional Council of Governments Planning Department. GIS data sources include the FRCOG Planning Department, the Massachusetts Highway Department, MassGIS, Massachusetts Natural Heritage and Endangered Species Program, and United States Fish and Wildlife Service. Digital data obtained from MassGIS represent the efforts of the Massachusetts Executive Office of Environmental Affairs and its agencies to record information from the sources cited in the associated documentation. EOEA maintains an ongoing program to record and correct errors in the GIS data that are brought to its attention. EOEA makes no claims as to the reliability of the GIS data or as to the implied validity of any uses of the GIS data. EOEA maintains records regarding all methods used to collect and process these digital data and will provide this information on request. Executive Office of Environmental Affairs, MassGIS EOEA Data Center, 251 Causeway Street, Suite 900, Boston, MA. 617-626-1000.

Road data provided by MassHighway. Town boundary, rail line, river, steam, pond, certified vernal pools, potential vernal pools, priority habitats for state-protected rare species, estimated habitats for rare wildlife, National Wetlands Inventory, Livings Waters, and Biomap data provided by MassGIS.

Note: Depicted boundaries are approximate and are intended for planning purposes only. Portions of the source data were obtained from 1:100,000 scale maps, therefore the accuracy of the line work on this map is +/-100 feet.

Legend

- State boundary
- Town boundary
- Rail line
- River, stream
- Minor roads
- Major roads
- Sub-watershed boundary
- Water body
- National Wetlands Inventory wetland
- 1-14 Sub-basins (see table)
- MRIP Natural Lands Riparian Corridors
- NHESP Potential Vernal Pools: NOT equivalent to Certified Vernal Pools
- NHESP 2003 Massachusetts Certified Vernal Pools
- NHESP Living Waters Core Habitats
- NHESP Living Waters Critical Supporting Watershed
- NHESP BioMap Core Habitat
- NHESP BioMap Supporting Natural Landscape
- NHESP 2003 Priority Habitats for State-Protected Rare Species
- NHESP 2003 Estimated Habitats for Rare Wildlife: For use with the MA Wetlands Protection Act Regulations (310 CMR 10).

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The most viable populations of rare plants are delineated as Core Habitats on the BioMap and Living Waters map. The list presented in Table 2-14 presents species of concern in Massachusetts. These species are classified as Endangered, Threatened or Special Concern. Endangered (E) species are native species in danger of extinction throughout all or part of their range, or in danger of extirpation from Massachusetts, as documented by biological research and inventory. Threatened (T) species are native species that are likely to become endangered in the foreseeable future, or that are declining or rare as determined by biological research and inventory. Special concern (SC) species are native species which have been documented by biological research or inventory to have suffered a decline that could threaten the species if allowed to continue unchecked, or which occurs in such small numbers or with such restricted distribution or specialized habitat requirements that they could easily become threatened within Massachusetts. Permanently protecting the habitats of these species should be considered a top priority.

Natural Communities

Twenty-three different types of natural communities have been documented from the Millers River watershed. Many of these are large or good-condition examples of common natural communities, such as Oak-Hemlock-White Pine Forest, but several are uncommon statewide, such as Hickory-Hop Hornbeam Forest/Woodland and Kettlehole Level Bog. More information on each of these community types is available from the draft Classification of the Natural Communities of Massachusetts, produced by the Natural Heritage Program and available online at http://www.state.ma.us/DFG/dfw/nhesp/nhclass.htm. The best examples of these communities are mapped in the BioMap.

Table 2-14

Rare Species of the Millers River Watershed

Common Name	Scientific Name	State Status
American Bittern	*Botaurus lentiginosus*	E
Sedge Wren	*Cistothorus platensis*	E
Giant St.-John's-Wort	*Hypericum ascyron*	E
Foxtail Clubmoss	*Lycopodiella alopecuroides*	E
Muskflower	*Mimulus moschatus*	E
Pod-grass	*Scheuchzeria palustris*	E
Northeastern Bulrush	*Scirpus ancistrochaetus*	E
Zebra Clubtail dragonfly	*Stylurus scudderi*	E
Sand Violet	*Viola adunca*	E
Name not revealed (insect)	--	E
Subarctic Darner dragonfly	*Aeshna subarctica*	T
Bartram's Shadbush	*Amelanchier bartramiana*	T
Grasshopper Sparrow	*Ammodramus savannarum*	T
Vesper Sparrow	*Pooecetes gramineus*	T
Incurvate Emerald dragonfly	*Somatochlora incurvata*	T
Sharp- shinned Hawk	*Accipiter striatus*	SC
Triangle Floater mussel	*Alasmidonta undulata*	SC
Jefferson Salamander	*Ambystoma jeffersonianum*	SC
Blue-spotted Salamander	*Ambystoma laterale*	SC
Dwarf Mistletoe	*Arceuthobium pusillum*	SC
Spotted Turtle	*Clemmys guttata*	SC
Wood Turtle	*Clemmys insculpta*	SC
Elderberry Longhorned Beetle	*Desmocerus palliatus*	SC
New England Bluet damselfly	*Enallagma laterale*	SC
Intricate Fairy Shrimp	*Eubranchipus intricatus*	SC
Common Loon	*Gavia immer*	SC
Beaver Pond Clubtail dragonfly	*Gomphus borealis*	SC
Spring Salamander	*Gyrinophilus porphyriticus*	SC
Slender Clearwing Sphinx Moth	*Hemaris gracilis*	SC
Four-toed Salamander	*Hemidactylium scutatum*	SC
New England Blazing Star plant	*Liatris borealis*	SC
Bridle Shiner	*Notropis bifrenatus*	SC
Brook Snaketail dragonfly	*Ophiogomphus aspersus*	SC
Oak Hairstreak butterfly	*Satyrium favonius*	SC
Ski-tailed Emerald dragonfly	*Somatochlora elongata*	SC
Forcipate Emerald dragonfly	*Somatochlora forcipata*	SC
Creeper mussel	*Strophitus undulatus*	SC
Eastern Box Turtle	*Terrapene carolina*	SC

Notes: E – Endangered; T – Threatened; SC – Species of Special Concern. Natural Heritage does not reveal the name of some species that are particularly susceptible to over-collection.

Table 2-15

Natural Communities of the Millers River Watershed

Natural Community Name
Acidic Graminoid Fen
Acidic Rock Cliff Community
Acidic Rocky Summit/Rock Outcrop Community
Acidic Shrub Fen
Acidic Talus Forest/Woodland
Circumneutral Talus Forest/Woodland
Forest Seep Community
Hickory - Hop Hornbeam Forest/Woodland
High-Energy Riverbank
Inland Acidic Pondshore/Lakeshore
Kettlehole Level Bog
Level Bog
Low-Energy Riverbank
Major-River Floodplain Forest
Northern Hardwoods - Hemlock - White Pine Forest
Oak - Hemlock - White Pine Forest
Pitch Pine - Scrub Oak Community
Shallow Emergent Marsh
Shrub Swamp
Spruce - Fir - Northern Hardwoods Forest
Spruce-Fir Boreal Swamp
Spruce-Tamarack Bog
White Pine - Oak Forest

Land Use Patterns and Changes[58]

In the past, tool manufacturing and furniture-making were dominant industries in the watershed, but most of these factories have since closed and the area supports light industrial and service-oriented businesses. The wide array of natural resources, opportunities for recreation, low cost of living, and rural community character, make the Millers River Watershed an attractive place to live. As more people migrate into the region, many of the watershed communities are growing at an unprecedented pace.

Population Growth

According to the 2000 U.S. Census, Gardner and Athol are the two largest population centers in the watershed with 20,770 and 11,299 residents respectively. Collectively, these towns represent over one-third of the total population (91,986) of the watershed. Many towns in the

[58] Information for this section adapted Montachusett Regional Planning Commission and the Franklin Regional Council of Governments, op.cit.

watershed experienced some of the highest growth rates in the Commonwealth of Massachusetts in the decade between 1980 and 1990. Since 1980, the population of watershed communities has increased from 76,118 to 91,986, an increase of 15,868 residents or twenty percent (20%). The growth pressure was greatest in the watershed communities located in Worcester County, with a total of 13,330 new residents locating in these communities (84% of the total growth). Watershed communities located in Franklin County increased by a total of 2,538 new residents (16% of the total growth). The five communities with the greatest population increases since 1980 are Gardner (2,870), Winchendon (2,592), Hubbardston (2,112), Westminster (1,768), and Ashburnham (1,471). Towns whose populations grew the least were Petersham, Templeton, Athol, Erving and Warwick. The populations, growth rates, and densities per mile of municipalities in the watershed are shown in the Table 2-16.

Land Use Change

Over a twenty-eight (28) year period from 1971 to 1999 a significant change in land uses occurred in the watershed. Forestland, cropland and pastureland categories all lost significant acreage while residential, commercial, and industrial land uses gained acreage. In that time period, over 6,670 acres of forest and 889 acres of agricultural land were lost to development. Residential uses account for 5,800 acres. Most new residential uses involve construction of single-family homes on large lots.

According to the most recent MacConnell land use data for the Millers River Watershed (1999) which is available from MassGIS, the Millers River Watershed in Massachusetts encompasses 310 square miles (198,669) acres. Most of the watershed, approximately 86% of the total land area area, is undeveloped and includes forest, wetland, open land and water. Approximately 21,344 acres of land is developed and represents 11% of the total land area. The developed land category includes mining, all residential development, commercial and industrial development, urban open land, transportation, and waste disposal. Most of this development is located in the Otter River and Middle Millers River subwatersheds in the communities of Gardner, Templeton, Athol, and Orange. These urban areas account for 67% of the developed lands throughout the watershed. Only 6,280 acres of the watershed are considered agricultural land. This category includes pasture, cropland, orchard, and woody perennial. Of these lands, over 51% are in the Otter River and Middle Millers River subwatersheds. Most farms in the watershed are small, encompassing less than fifty acres on average.

Approximately 78% or 154,615 acres of the watershed is forested. Residential uses account for approximately 8% of the land area or 15,816 acres. Agricultural uses such as cropland and pasture, orchards, and nurseries represent 3.0% of the land area or 6,279 acres. Commercial, Industrial, Transportation, and Waste Disposal uses account for just 1.6%, or 3,212 acres.

Millers River 5-Year Watershed Action Plan

Growth Trends 1971 - 1999

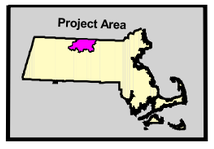
New Hampshire
Massachusetts

ROYALSTON
WINCHENDON
ASHBURNHAM
WARWICK
NORTHFIELD
ORANGE
ERVING
WENDELL
ATHOL
PHILLIPSTON
TEMPLETON
GARDNER
MONTAGUE
NEW SALEM
PETERSHAM
HUBBARDSTON
WESTMINSTER

N
W E
S

0 1 2 3 4 5 6 Miles

FRANKLIN REGIONAL COUNCIL OF GOVERNMENTS
Main Office: 413-774-3167
425 Main Street
Greenfield, Massachusetts 01301



Sub-basin	Number	Sub-basin	Number
Lower Millers	1	Tarbell Brook	8
Whetstone Brook	2	Scott Preist Brook	9
Lake Rohunta	3	Lawrence Brook	10
Middle Millers River	4	Tully River	11
Otter River	5	West Brook	12
Upper Millers River	6	Gales Brook	13
North Branch Millers	7	Moss Brook	14

Map Sources:

Map produced by The Franklin Regional Council of Governments Planning Department. GIS data sources include the FRCOG Planning Department, the Massachusetts Highway Department, MassGIS, Massachusetts Natural Heritage and Endangered Species Program, and United States Fish and Wildlife Service. Digital data obtained from MassGIS represent the efforts of the Massachusetts Executive Office of Environmental Affairs and its agencies to record information from the sources cited in the associated documentation. EOEA maintains an ongoing program to record and correct errors in the GIS data that are brought to its attention. EOEA makes no claims as to the reliability of the GIS data or as to the implied validity of any uses of the GIS data. EOEA maintains records regarding all methods used to collect and process these digital data and will provide this information on request. Executive Office of Environmental Affairs, MassGIS EOEA Data Center, 251 Causeway Street, Suite 900, Boston, MA, 617-626-1000.

Road data provided by MassHighway. Town boundary, rail line, river, steam, pond, land use, protected open space, wellhead protection area, surface water supply protection area, and National Wetlands Inventory data provided by MassGIS.

Note: Depicted boundaries are approximate and are intended for planning purposes only. Portions of the source data were obtained from 1:100,000 scale maps, therefore the accuracy of the line work on this map is +/-100 feet.

Legend

- State boundary
- Town boundary
- Rail line
- River, stream
- Minor road
- Major road
- Water body
- 1-14 Sub-basins (see table)
- Sub-watershed boundary
- National Wetlands Inventory wetland
- Protected open space
- DEP Wellhead Protection Area
- Land use change (1971-1999)
- Zone A Surface Water Protection Area
- Zone B Surface Water Protection Area

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Table 2-16
Populations of Municipalities included in the Millers River Watershed[59]

	1980	1990	Change	Percent Change 1980-90	2000	Change	Percent Change 1990-2000	Population Density/ Square Mile
Worcester County Towns								
Ashburnham	4,075	5,433	1,358	33%	5,546	113	2%	143
Athol	10,634	11,451	817	8%	11,299	-152	-1%	347
Gardner	17,900	20,125	2,225	12%	20,770	645	3%	936
Hubbardston	1,797	2,797	1,000	56%	3,909	1,112	40%	95
Petersham	1,024	1,131	107	10%	1,180	49	4%	22
Phillipston	953	1,485	532	56%	1,621	136	9%	67
Royalston	955	1,147	192	20%	1,254	107	9%	30
Templeton	6,070	6,438	368	6%	6,799	361	6%	212
Westminster	5,139	6,191	1,052	20%	6,907	716	12%	195
Winchendon	7,019	8,805	1,786	25%	9,611	806	9%	222
Total	**55,566**	**65,003**	**9,437**	**17%**	**68,896**	**3,893**	**6%**	**184**
Franklin County Towns								
Erving	1,326	1,372	46	3%	1,467	95	7%	102
Montague	8,011	8,316	305	4%	8,489	173	2%	267
New Salem	688	802	114	17%	929	127	16%	16
Northfield	2,386	2,838	452	19%	2,951	113	4%	83
Orange	6,844	7,321	468	7%	7,518	206	3%	209
Warwick	603	740	137	23%	750	10	1%	20
Wendell	694	899	205	30%	986	87	10%	31
Total	**20,552**	**22,279**	**1,727**	**8%**	**23,090**	**811**	**4%**	**94**
Total for Watershed	**76,118**	**87,282**	**11,164**	**15%**	**91,986**	**4,704**	**5%**	**149**

[59] Table adapted from the Montachusett Regional Planning Commission and the Franklin Regional Council of Governments, op.cit.

Table 2-17

Summary of 1999 Land Use by Subwatershed[60]

	Undeveloped Land		Developed Land		Agricultural Land	
Subwatershed	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
North Branch Millers River	1,213	0.7%	156	0.7%	9	0.2%
Upper Millers River	15,732	9.2%	1,491	7.0%	159	2.5%
Otter River	30,116	17.6%	8,042	37.7%	1,294	20.6%
Middle Millers River	32,351	18.9%	6,401	30.0%	1,939	30.9%
Tarbell Brook	3,233	1.9%	488	2.3%	92	1.5%
Preist Brook	6,057	3.5%	133	0.6%	92	1.5%
Lawrence Brook	8,637	5.0%	263	1.2%	318	5.1%
Tully River	19,969	11.7%	1,081	5.1%	860	13.7%
Lake Rohunta	11,483	6.7%	1,155	5.4%	331	5.3%
West Brook	5,121	3.0%	340	1.6%	395	6.3%
Gales Brook	5,937	3.5%	281	1.3%	242	3.8%
Moss Brook	7,408	4.3%	255	1.2%	162	2.6%
Whetstone Brook	3,314	1.9%	36	0.2%	-	0.0%
Lower Millers River	20,476	12.0%	1,220	5.7%	387	6.2%
Subwatershed Total	**171,046**	**100%**	**21,344**	**100%**	**6,280**	**100%**
Percent of Millers River Watershed		86%		11%		3%

[60]Table adapted from the Montachusett Regional Planning Commission and the Franklin Regional Council of Governments, op.cit.

Table 2-18

Millers River Watershed 1999 Acreage by Land Use Category[61]

Land Use Code	Land Use Category	Acres	Percent Of Total Land Area
1	Cropland (Intensive Agriculture)	3,271	1.6%
2	Pasture (Extensive Agriculture)	2,760	1.4%
3	Forestland	154,615	77.8%
4	Wetland (Non-forested freshwater)	6,052	3.0%
5	Mining (Sand, Gravel, and Rock)	1,191	0.6%
6	Open Land (Abandoned agriculture, areas of no vegetation)	3,698	1.9%
7	Participation Recreation (Golf, Tennis, Playgrounds, skiing)	935	0.5%
8	Spectator Recreation (Stadiums, racetracks, fairgrounds, drive-ins)	19	0.0%
9	Water Based Recreation (Beaches, Marinas, Swimming Pools)	39	0.0%
10	Residential Multifamily	182	0.1%
11	Residential < 1/4 acre lot	1,237	0.6%
12	Residential 1/4 - 1/2 acre lot	4,025	2.0%
13	Residential > 1/2 acre lot	10,372	5.2%
15	Commercial (General Urban, shopping center)	749	0.4%
16	Industrial (Light and Heavy Industry)	881	0.4%
17	Urban Open (Parks, public & institutional green space, vacant undeveloped land)	1,366	0.7%
18	Transportation (Airports, docks, divided highway, freight storage, railroads)	1,257	0.6%
19	Waste Disposal (Landfills, sewage lagoons)	457	0.2%
20	Water (Freshwater, coastal embayment)	5,316	2.7%
21	Woody Perennial (Orchard, Nursery, Cranberry bog)	248	0.1%
	Total Land Area	**198,669**	**100%**

[61] Table adapted from Montachusetts Regional Planning Commission and the Franklin Regional Council of Governments, op.cit.

Table 2-19 1999 Land Uses by Subwatershed[62]

Land Use Category	North Branch Millers River	Upper Millers River	Otter River	Middle Millers River	Tarbell Brook	Preist Brook	Lawrence Brook	Tully River	Lake Rohunta	West Brook	Gales Brook	Moss Brook	Whetstone Brook	Lower Millers River	Total Acres	% of Total Land Area
1 Cropland	7	38	667	1,064	76	36	159	600	142	259	50	49		126	3,271	1.6%
2 Pasture	3	111	576	746	16	56	159	248	177	108	189	113		260	2,760	1.4%
3 Forestland	998	13,320	26,033	29,313	2,981	5,627	7,946	18,306	10,139	4,807	5,582	7,053	3,215	19,292	154,615	77.8%
4 Wetland		888	1,356	883	179	322	515	605	443	88	193	223	58	298	6,052	3.0%
5 Mining		109	812	179	14	3	10	14	24		5		9	13	1,191	0.6%
6 Open Land	25	386	1,115	701	47	106	146	326	138	91	66	45	41	465	3,698	1.9%
7 Participation Recreation		47	319	342	2	2	4	5	157		21	14		22	935	0.5%
8 Spectator Recreation			19												19	0.0%
9 Water Based Recreation		2	14	15		2		0	1			3			39	0.0%
10 Residential Multifamily			76	81	7			4						13	182	0.1%
11 Residential < 1/4 acre lot			782	327	32			17		0				78	1,237	0.6%
12 Residential 1/4 - 1/2 acre lot		245	1,501	1,740	44			214	87	28	4	42		121	4,025	2.0%
13 Residential > 1/2 acre lot	155	1,026	2,870	2,514	318	126	228	793	847	275	240	196	24	761	10,372	5.2%
15 Commercial		32	317	314	13		3	1	4	37	4			23	749	0.4%
16 Industrial	2	1	443	298	30		14	22	7		7			57	881	0.4%
17 Urban Open		30	521	440	24	1	26	81	89	22	1	8		122	1,366	0.7%
18 Transportation		2	676	508	13				17					41	1,257	0.6%
19 Waste Disposal		26	213	83	13		5	11	12				4	90	457	0.2%
20 Water	189	1,107	1,090	1,013	2	1	5	650	674	112	93	78		299	5,316	2.7%
21 Woody Perennial		11	51	129				12	12	28	3			1	248	0.1%
Total Acres	**1,378**	**17,381**	**39,453**	**40,692**	**3,813**	**6,282**	**9,218**	**21,909**	**12,970**	**5,855**	**6,459**	**7,825**	**3,350**	**22,083**	**198,669**	**100%**

[62] Table adapted from the Montachusett Regional Planning Commission and the Franklin Regional Council of Governments, op.cit.

Table 2-20 1971 Land Uses by Subwatershed

Land Use Category	North Branch Millers River	Upper Millers River	Otter River	Middle Millers River	Tarbell Brook	Preist Brook	Lawrence Brook	Tully River	Lake Rohunta	West Brook	Gales Brook	Moss Brook	Whetstone Brook	Lower Millers River	Total Acres
1 Cropland	21	29	909	1,217	80	27	168	641	98	248	52	48		144	3,628
2 Pasture		192	729	963	50	67	222	323	233	132	245	118	1	314	3,448
3 Forestland	2,352	14,260	29,170	30,430	3,249	5,737	8,215	18,901	10,586	4,243	5,691	7,186	3,259	19,908	159,822
4 Wetland	20	931	1,248	776	170	268	440	373	431	43	141	170	38	232	5,583
5 Mining	8	16	302	91		3	11	21	40			3	9	33	799
6 Open Land	53	249	786	512	11	91	106	166	70	52	36	16	38	441	2,650
7 Participation Recreation		43	205	308	2	2	4	5	149	8	8	14		22	833
8 Spectator Recreation			19												19
9 Water Based Recreation		2	11	15					1			3			39
10 Residential Multifamily			13	22				3						1	131
11 Residential < 1/4 acre lot			780	263	30			17		0				78	1,212
12 Residential 1/4 - 1/2 acre lot	9	235	1,105	1,577	43			185	50	18	4	18		122	3,671
13 Residential > 1/2 acre lot	195	266	1,524	1,376	128	2	129	475	514	113	166	99	14	454	7,102
15 Commercial		11	216	273	11		3	1	4	25		25		23	621
16 Industrial	20	1	295	185	30			9	6					47	711
17 Urban Open	18	27	360	309	3		11	46	69	1	1	11		80	1,315
18 Transportation		1	592	484	5				20			11		34	1,221
19 Waste Disposal			89	72				45	7				2	25	470
20 Water	235	1,114	1,054	926	2		5	633	671	17	122	17		302	5,182
21 Woody Perennial		6	47	94					4	36	3	32		6	214
Total Acres	**2,930**	**17,382**	**39,453**	**39,893**	**3,814**	**6,249**	**9,314**	**21,849**	**12,955**	**4,922**	**6,459**	**7,825**	**3,360**	**22,268**	**198,673**

During the 1980's the region experienced a housing construction boom. A look at residential building permit data for the last decade indicates the pattern and pace of growth in the watershed. Many of these permits were part of large subdivisions of open land.

Table 2-21

Ten Year Pattern of Residential Building Permits[63]

Town	End Year of Building Permit Period	Building Permit 1990-1998 or 2000	Annualized Average Building Permits
Ashburnham	1998	277	34.6
Athol	1998	164	20.5
Erving	2000	37	3.7
Gardner	2000	432	43.2
Hubbardston	1998	415	51.9
Orange	2000	232	23.2
Petersham	2000	52	5.2
Phillipston	1998	683	85.4
Royalston	2000	55	5.5
Templeton	2000	315	31.5
Warwick	2000	36	3.6
Wendell	2000	45	4.5
Westminster	2000	452	45.2
Winchendon	1998	438	54.8
Total		**3633**	**413**

Development Potential[64]

Several years ago, the Executive Office of Environmental Affairs (EOEA) sponsored the creation of buildout analyses for all 351 towns and cities within the Commonwealth of Massachusetts. EOEA contracted with the Montachusett Regional Planning Commission and the Franklin Regional Council of Governments to develop buildouts for their respective communities. A buildout analysis illustrates the maximum development that can occur in a community based on the local zoning bylaws currently in place. The buildout provides an estimate of the total number of houses and commercial/industrial square footage that could result if:

1. Every piece of unprotected, buildable land is developed,
2. If no more land is permanently protected within a community, and

[63] Table adapted from Montachusett Regional Planning Commission and Franklin Regional Council of Governments, op.cit.
[64] Information for this section adapted from Montachusett Regional Planning Commission and Franklin Regional Council of Governments, op.cit.

3. If zoning remains unchanged.

The buildout analysis can provide a community with insight into the potential burdens on their infrastructure. The methodology used defines buildable land as undeveloped, unprotected, upland that does not include transmission lines or land within 100 feet of a stream or a river. The analysis reflects a community's zoning bylaws and regulations, especially concerning the way they treat resource areas such as wetlands and floodplains. For example, if wetland areas can be included in gross building lot area minimums, then wetlands are not considered an absolute constraint to development. Yet wetlands may be considered partial constraints if they restrict the density or type of development in a given area. For example, there may be 25% limit on all impervious surfaces on parcels located within a certain distance of a wetland. The methodology takes this into account.

The buildout analyses conducted by the Montachusett Regional Planning Commission and the Franklin Regional Council of Governments revealed that the Millers River Watershed communities have a total of 169,964 acres of residentially zoned developable land under current land use controls. Given existing zoning and use controls for commercial and industrial uses the region has potential for 142,889,365 square feet of floor area. If the region builds out under current zoning, planners can expect to see 96,237 new housing units. The population can be expected to increase by 255,849, nearly quadrupling the current population. If current family-size trends are extended, the student population would increase by 49,992, nearly tripling the current student body.

Total water demand would increase by 600%. This estimate was calculated using a formula specified by the buildout methodology. Actual water demand might be very different. Currently, the watershed has approximately 1,300 miles of roads, most of which are under local jurisdiction. At buildout, more than 1,800 miles of new roads would be built, most of these would be created to serve new housing and subdivisions. Local towns would be responsible for maintaining most of these new roads.

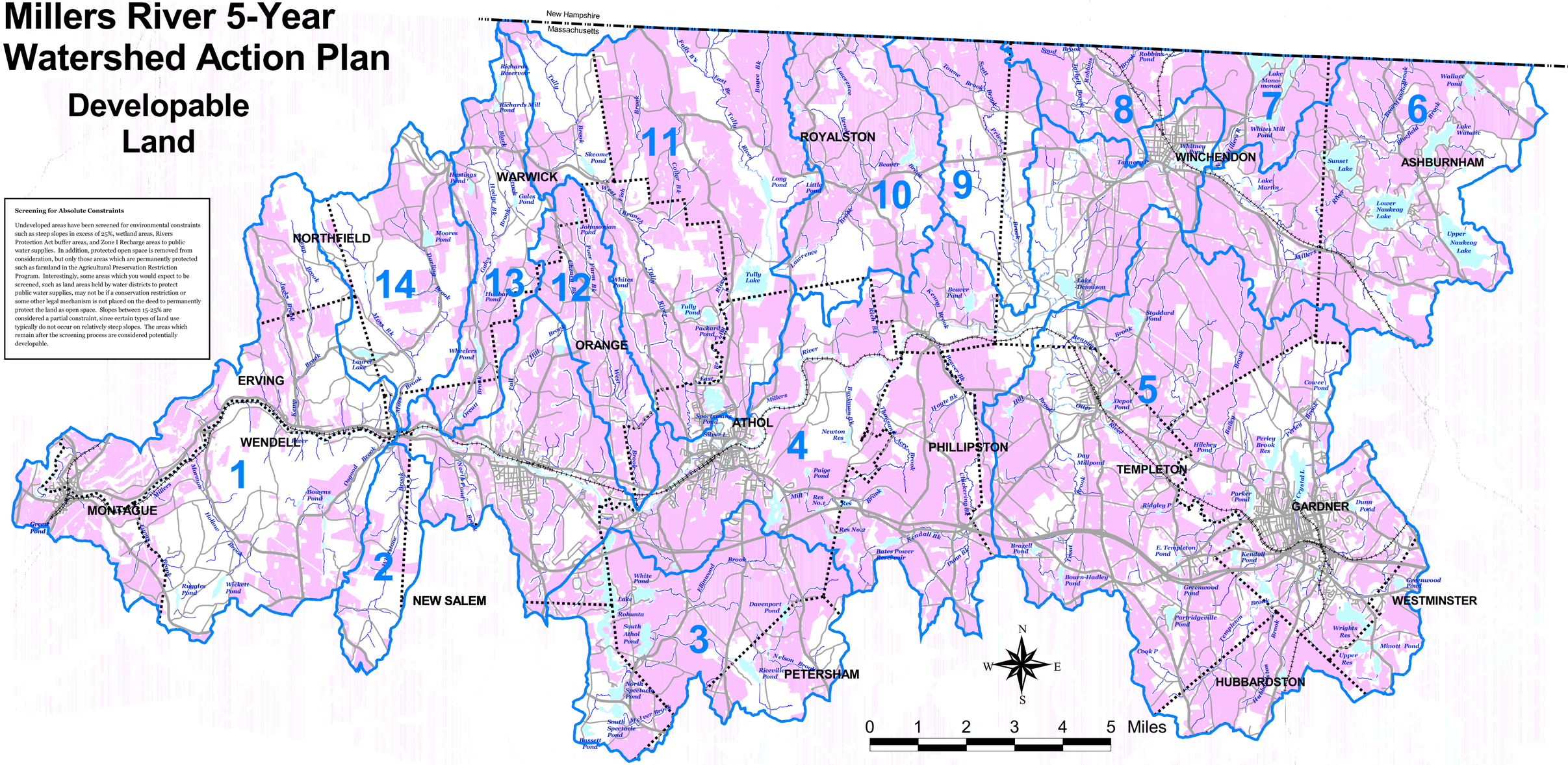
Although the likelihood that maximum build-out conditions would be reached is probably low; even a loss of 20% of the watershed's open space to unplanned, sprawling development could have a significant impact not only on municipal infrastructure and fiscal resources but also on the rural character and natural resources of the watershed.

Millers River 5-Year Watershed Action Plan

Developable Land

Screening for Absolute Constraints

Undeveloped areas have been screened for environmental constraints such as steep slopes in excess of 25%, wetland areas, Rivers Protection Act buffer areas, and Zone I Recharge areas to public water supplies. In addition, protected open space is removed from consideration, but only those areas which are permanently protected such as farmland in the Agricultural Preservation Restriction Program. Interestingly, some areas which you would expect to be screened, such as land areas held by water districts to protect public water supplies, may not be if a conservation restriction or some other legal mechanism is not placed on the deed to permanently protect the land as open space. Slopes between 15-25% are considered a partial constraint, since certain types of land use typically do not occur on relatively steep slopes. The areas which remain after the screening process are considered potentially developable.



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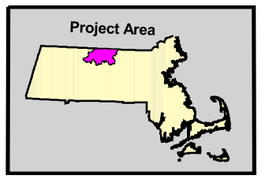
Greenfield, Massachusetts 01301



June 29, 2004

Sub-basin	Number	Sub-basin	Number
Lower Millers	1	Tarbell Brook	8
Whetstone Brook	2	Priest Brook	9
Lake Rohunta	3	Lawrence Brook	10
Middle Millers River	4	Tully River	11
Otter River	5	West Brook	12
Upper Millers River	6	Gales Brook	13
North Branch Millers	7	Moss Brook	14

Map Sources:

Map produced by The Franklin Regional Council of Governments Planning Department. GIS data sources include the FRCOG Planning Department, the Massachusetts Highway Department, MassGIS, Massachusetts Natural Heritage and Endangered Species Program, and United States Fish and Wildlife Service. Digital data obtained from MassGIS represent the efforts of the Massachusetts Executive Office of Environmental Affairs and its agencies to record information from the sources cited in the associated documentation. EOEA maintains an ongoing program to record and correct errors in the GIS data that are brought to its attention. EOEA makes no claims as to the reliability of the GIS data or as to the implied validity of any uses of the GIS data. EOEA maintains records regarding all methods used to collect and process these digital data and will provide this information on request. Executive Office of Environmental Affairs, MassGIS EOEA Data Center, 251 Causeway Street, Suite 900, Boston, MA, 617-626-1000.

Road data provided by MassHighway. Town boundary, rail line, river, steam, and pond data provided by MassGIS. Worcester County Potentially Developable Land data provided by Montachusett Regional Planning Council.

Note: Depicted boundaries are approximate and are intended for planning purposes only. Portions of the source data were obtained from 1:100,000 scale maps, therefore the accuracy of the line work on this map is +/-100 feet.

Legend

- Water body
- Potentially Developable Land
- Sub-watershed boundary
- 1-14 Sub-basins (see table)
- State boundary
- Town boundary
- Rail line
- River, stream

Roads

- Minor roads
- Major roads

Table 2-22

Buildout Analysis Summary Statistics for Millers River Watershed[65]

Buildout Impact for the Millers River Watershed	Current	Additional	Future
Current Population	89,164		
Additional Residents		255,849	
Future Population			345,013
Current Students	21,687		
Additional School Children		49,992	
Future Students			71,679
Current Households	34,391		
Additional Dwelling Units		96,237	
Future Households			130,628
Residential Developable Land Area (sq. ft.)		7,403,627,328	
Residential Developable Land Area (acres)		169,964	
Commercial/Industrial Buildable Floor Area (sq. ft.)		142,889,365	
Current Water Demand (gallons per day)	5,818,175		
Additional Water Demand (gallons/day)		29,874,268	
Residential Water Use (gallons/day)		*19,157,565*	
Comm./Ind. Water Use (gallons/day)		*10,716,703,*	
Future Water Demand			35,692,443
Additional Municipal Solid Waste (tons/year)		117,440	
Non-Recycled Solid Waste (tons/year)		*93,183*	
Recyclable Solid Waste (tons/year)		*28,837*	
Current Road Miles	1,316		
Additional Road Miles		1,841	
Future Road Miles			3,157

Open Space and Recreation

The firm of McGregor and Associates, under a contract funded by the Massachusetts Executive Office of Environmental Affairs, is currently developing a Regional Open Space and Recreation Plan for the Millers River Watershed. The Regional Open Space

[65] Table adapted from Montachusetts Regional Planning Commission and Franklin Regional Council of Governments, op.cit.

Plan will inventory open space and recreational resources in the watershed and include an Action Plan that describes strategies to address natural resource protection, open space preservation, and recreation issues for the entire watershed. Available information from a May 25, 2004 draft of the Regional Open Space Plan was incorporated into this Watershed Action Plan. Once the Final Regional Open Space Plan is released, relevant chapters of this Watershed Action Plan should be updated.

Protected Lands[66]

The Millers River Watershed has a substantial amount of land that has already been protected from development due to the efforts of government agencies, private conservation organizations, and private citizens. According to most recent records on file with MassGIS (2003), of the 198,673 acres in the watershed, 56,802 acres are protected open space, representing 29% of the entire watershed. Protected Open Space refers to lands that are protected "in perpetuity" and includes state forests and parks, lands managed by local land trusts, and private lands that have a deed restriction for conservation or agricultural purposes. The Commonwealth of Massachusetts owns more than two-thirds of the protected open space at 36,887 acres (65%). State forests and wildlife management areas account for most of this land. The table below shows the amount of protected open space by subwatershed and jurisdiction.

In addition to permanently protected open space, there are approximately 727 acres of open space owned by municipalities in the watershed. These lands are generally used for schools, cemeteries, municipal buildings, parks, playgrounds, and Departments of Public works facilities for highway management and water treatment. In general, these are lands that are considered to have limited protection from development because, unless the land is under the control of a local Conservation Commission, the use could be relatively easily converted from open space to some other use. The table below lists the lands with limited protection from development in the watershed. The data in this table is current as of August 2000 and should be updated with current data when the Regional Open Space Plan is finalized.

[66] Information for this section was adapted from Montachusett Regional Planning Commission and the Franklin Regional Council of Governments, op.cit., and was updated with information from MassGIS.

Millers River 5-Year Watershed Action Plan

Protected Open Space and Current and Potential Public Access

New Hampshire
Massachusetts

Arbustus Sanctuary

ROYALSTON
WINCHENDON
ASHBURNHAM
WARWICK
NORTHFIELD
ORANGE
ERVING
WENDELL
ATHOL
PHILLIPSTON
TEMPLETON
GARDNER
MONTAGUE
NEW SALEM
WESTMINSTER
PETERSHAM
HUBBARDSTON

Customs House
Millers Falls - Rt. 63 Canoe\Walking Access
Millers Falls Bridge

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Greenfield, Massachusetts 01301

September 2004

Project Area

N
W E
S

0 1 2 3 4 5 Miles

Map Sources:

Map produced by The Franklin Regional Council of Governments Planning Department. GIS data sources include the FRCOG Planning Department, the Massachusetts Highway Department, MassGIS, Massachusetts Natural Heritage and Endangered Species Program, and United States Fish and Wildlife Service. Digital data obtained from MassGIS represent the efforts of the Massachusetts Executive Office of Environmental Affairs and its agencies to record information from the sources cited in the associated documentation. EOEA maintains an ongoing program to record and correct errors in the GIS data that are brought to its attention. EOEA makes no claims as to the reliability of the GIS data or as to the implied validity of any uses of the GIS data. EOEA maintains records regarding all methods used to collect and process these digital data and will provide this information on request. Executive Office of Environmental Affairs, MassGIS EOEA Data Center, 251 Causeway Street, Suite 900, Boston, MA, 617-626-1000.

Road data provided by MassHighway. Town boundary, rail line, river, steam, pond, protected open space, public access board sites, tracks and trail, long distance trail, and National Wetlands Inventory data provided by MassGIS.

Note: Depicted boundaries are approximate and are intended for planning purposes only. Portions of the source data were obtained from 1:100,000 scale maps, therefore the accuracy of the line work on this map is +/-100 feet.

Legend

- Point of Interest
- Potential Public Access Point
- Public Canoe Access
- Public Access Board site
- Water body
- Sub-watershed boundary
- National Wetlands Inventory wetland
- Protected open space
- State boundary
- Town boundary
- Rail line
- River, stream
- Minor road
- Major road
- Tracks and trails
- Tully Lake trails
- Long distance trail

Table 2-23 – Lands with Limited Protection from Development[67]

Subwatershed	Owner	Total Acres
Upper Millers River	Ashburnham Municipal Property	75.3
	Winchendon Property	0.2
Otter River	Narragansett Regional School District	51.7
	Templeton Schools	16.1
	Winchendon Property	2.2
Middle Millers River	B&M Railroad	106.1
	Mahar Regional School District	5.7
	Athol Schools	37.4
	Orange Municipal Properties	109.3
	Phillipston Municipal Property	38.6
	Winchendon Schools	68.6
Tarbell Brook	Winchendon Schools	4.5
Tully River	Orange Municipal Properties	23.6
	Warwick Property	10.3
	Gale Brook School	2.5
Lake Rohunta	Athol Schools	47.5
West Brook	Orange – Jones Cemetery	15.0
	North Orange Cemetery	1.4
Lower Millers River	Wendell Municipal Properties	110.9
Total Acres		**726.9**

Under the Massachusetts General Tax Laws, Chapters 61, 61A, and 61B, landowners who are willing to keep agricultural, forested, or recreational lands open are given a tax abatement. However, these lands are not considered permanently protected. If a landowner chooses to sell the land, the town is given the right of first refusal unless ownership of the land will be transferred to a family member.

According to the available data (2003 MassGIS data), a total of 10,184 acres of land are listed under the Chapter 61 program. Of these acres, most are enrolled in the forestry program. Lands in this program are listed for ten-year periods, during which time the land is generally used for forestry purposes. Logging practices are subject to State law governing cutting practices and large-scale operations must conform to laws and regulations governing erosion control. The rest of the acreage is listed either in the Agricultural program (Ch 61A - active or passive and can include the buildings and roads required for farming the land) or Chapter 61 B (open space, private camping grounds,

[67] Table adapted from Montachusett Regional Planning Commission and the Franklin Regional Council of Governments, op.cit.

sportsmen's clubs, etc). The Chapter 61 information should be tracked and updated annually since change is fairly constant in this program. Land can be withdrawn from the Chapter 61 program and converted to either protected open space, recreation facilities, residential subdivisions, or industrial complexes. The inventory of lands enrolled in the Chapter 61 program should be updated with data from the Regional Open Space Plan.

The following table is an inventory of the major parcels of open space in the Millers River Watershed. However, not all of the listed parcels are permanently protected open space. Property owned by a municipality, a corporate or non-profit entity, or an individual may not be permanently protected unless the property has a conservation restriction or is under the control of the local Conservation Commission.

Table 2-24
Millers River Watershed Open Space Inventory -- Major Parcels[68]

Parcel Name	Town	Owner	Total Acres
Ashburnham State Forest	Ashburnham	DCR	1,593.62
Watatic Mountain Sanctuary	Ashburnham	DFG	91.34
	Ashburnham	Mount Grace Land Conservation Trust	164.87
Petersham State Forest	Athol	DCR	98.90
Tully River Reservation	Athol	USACE	47.49
Millers River WMA	Athol	DFG	472.54
Lawton State Forest	Athol	DCR	343.08
Boston and Maine RR	Athol	BMRR	72.13
Bearsden Forest Conservation Area	Athol	Town of Athol	322.65
Morgan Memorial Complex	Athol	Morgan Memorial Children's Camp	219.90
Bearsden Watershed/Newton Reservoir	Athol	Town of Athol	40.11
Erving State Forest	Erving	DCR	1,928.00
Hubbardston State Forest	Hubbardston	DCR	100.52
Montague Plains	Montague	Quinnetuk Company	250.00
Northfield State Forest	Northfield	DCR	1,600.00
Wendell State Forest	Orange	DCR	116.00
Orange State Forest	Orange	DCR	610.00
Hosmer Woods	Orange	NEFF	204.67
Orange WMA	Orange	DFG	276.82
Warwick WMA	Orange	DFG	58.00
Warwick State Forest	Orange	DCR	134.31
Tully Mountain WMA	Orange	DFG	348.33

[68] Table adapted from McGregor and Associates, Draft Millers River Regional Open Space Plan, May 25, 2004.

Table 2-24
Millers River Watershed Open Space Inventory -- Major Parcels[68]

Parcel Name	Town	Owner	Total Acres
Tully River 1	Orange	William Foye	212.30
Millers River WMA	Phillipston	DFG	72.07
Beaver Brook	Phillipston	Comm. Of MA	222.81
Athol Watershed	Phillipston	Town of Phillipston	40.70
Warwick State Forest	Royalston	DCR	64.16
Fish Brook WMA	Royalston	DFG	121.83
Royalston State Forest	Royalston	DCR	656.70
Royalston Falls	Royalston	TTOR	198.82
Tully Lake	Royalston	USACE	1,257.00
Jacobs Hill Reservation	Royalston	TTOR	156.00
Millers River WMA	Royalston	DFG	398.48
Chase Memorial Forest	Royalston	NEFF	64.22
Birch Hill WMA	Royalston	DFG	1,616.55
Otter River State Forest	Royalston	DCR	52.55
Lawrence Brook WMA	Royalston	DFG	187.66
Tully Lake	Royalston	USACE	380.99
The Ledges	Royalston	TTOR	37.64
Otter River State Forest	Templeton	DCR	427.43
Templeton State Forest	Templeton	DCR	477.83
Birch Hill	Templeton	USACE	1,064.32
Floodswood Conservation Area	Templeton	Town of Templeton	129.45
Templeton Fish and Game Club	Templeton	TFGC	119.70
Peaceful Pines Campground	Templeton	Marie Buckley	71.53
Royalston Fish and Game Club	Templeton	RFGC Inc.	125.20
Warwick State Forest	Warwick	DCR	7,401.35

Table 2-24
Millers River Watershed Open Space Inventory -- Major Parcels[68]

Parcel Name	Town	Owner	Total Acres
Town Forest	Warwick	Town of Warwick	68.88
Darling Brook	Warwick	MGLCT	79.88
Mt. Grace State Forest	Warwick	DCR	1,545.55
Tully Brook Access Area	Warwick	DFG	118.18
Mallard Hill	Warwick	Joyce/Vogt	119.11
Warwick WMA	Warwick	DFG	112.13
Wendell State Forest	Wendell	DCR	6,599.72
Whetstone Wood Wildlife Sanctuary	Wendell	MAS	973.07
CR #4	Wendell	Private w/CR	70.27
Westminster State Forest	Westminster	DCR	93.77
Birch Hill WMA	Winchendon	DFG	1,175.55
	Winchendon	USACE	57.46
Lake Dennison State Recreation Area	Winchendon	USACE	2,427.00
Otter River State Forest	Winchendon	DCR	428.89
Winchendon State Forest	Winchendon	DCR	171.77
Millers River WMA	Winchendon	DFG	194.95
Winchendon School	Winchendon	Winchendon School Inc.	188.99
Town Forest	Winchendon	Town of Winchendon	69.84
Total			**39,145.58**

Notes: DCR – Massachusetts Department of Conservation & Recreation; DFG – Massachusetts Department of Fish & Game; USACE – U.S. Army Corps of Engineers; MAS – Massachusetts Audubon Society; NEFF – New England Forestry Foundation; TTOR – The Trustees of Reservations; Private w/CR – privately owned land with a conservation restriction in place.

Recreation[69]

The Millers River and many of its tributaries offer sport fisherman opportunities to catch largemouth bass, brown trout, and rainbow trout (both native and stocked). The Appalachian Mountain Club Guide to Freshwater Fishing in New England describes

[69] This section should be augmented once the 2004 Regional Open Space & Recreation Plan is issued.

other freshwater fishing opportunities present in the watershed, as listed in Table 2-25 by subwatershed and waterbody. The main fish species available in these waters include two estuarial species: White Perch and Rainbow Smelt; five warm water species: Horned Pout, Chain Pickerel, Northern Pike, Yellow Perch, and Largemouth bass; and four cold water species: Smallmouth Bass, Brown Trout, Rainbow Trout, and Common or White Sucker.

Table 2-25

Fishing Opportunities in Lakes and Ponds in the Millers River Watershed[70]

Subwatershed	Town	Fishing Opportunities
North Branch Millers River		
Lake Monomonac	Winchendon/Rindge, N.H.	White Perch, Horned Pout, Chain Pickerel, Yellow Perch
Upper Millers River		
Lower Naukeag Lake	Ashburnham	Horned Pout, Chain Pickerel, Yellow Perch
Otter River		
Kendall Pond	Gardner	Horned Pout, Chain Pickerel, Yellow Perch
Dunn Pond	Gardner	Horned Pout, Chain Pickerel
Middle Millers River		
Lake Mattawa (North Pond Brook Reservoir)	Orange	Rainbow Smelt, Horned Pout, Chain Pickerel, Yellow Perch, Rainbow Trout
Lake Dennison	Winchendon	White Perch, Rainbow Smelt, Horned Pout, Chain Pickerel, Yellow Perch
Whitney Pond	Winchendon	Chain Pickerel, Largemouth Bass
Tully River		
Tully Lake	Royalston	Horned Pout, Chain Pickerel
Sheomet Lake	Warwick	Brown Trout
Lake Rohunta		
Lake Rohunta	Athol/Orange/New Salem	Horned Pout, Chain Pickerel, Northern Pike, Yellow Perch
Gales Brook		
Moores Pond	Warwick	White Perch, Horned Pout, Chain Pickerel, Yellow Perch
Moss Brook		
Laurel Lake	Erving/Warwick	Horned Pout, Chain Pickerel, Rainbow Trout

[70] Table adapted from Montachusett Regional Planning Commission and Franklin Regional Council of Governments, op.cit. Original source of information for the table is the AMC Guide to Freshwater Fishing in New England, Brian R. Kologe, Appalachian Mountain Club, © 1991, First Printing 1947.

The Massachusetts Department of Fish and Game (MA DFG) stocks selected waters in the Millers River watershed with trout for recreational fishing. Table 2-26 is a list of stocked waters as shown on the DFG's website (www.mass.gov/dfwele/dfw/). For most waters, stocking typically occurs in the spring; however, some waters are also stocked in the fall as well. Through an Atlantic salmon reintroduction program initiated in 1983, salmon fry have been stocked throughout the length of the Millers River below the Birch Hill Dam.

Table 2-26

Trout Stocked Waters of Millers River Watershed

Town	Waterbody
Ashburnham	Phillips Brook, Whitman River
Athol	Ellinwood Brook, West Brook, Tully River, Millers River, Silver Lake
Erving	Keyup Brook, Laurel Lake, Millers River
Gardner	Kendall Pond, Dunn Pond, Otter River
Hubbardston	Natty Pond Brook, Burnshirt River, Asnacomet Pond, Canesto Brook, Joslin Brook, Ware River (West Branch and East Branch)
Montague	Goddard Brook, Sawmill River, West Pond, Millers River
New Salem	Swift River (Middle Branch)
Northfield	Four Mile Brook, Mill Brook, Roaring Brook, Pauchaug Brook
Orange	Tully Brook (W. Branch), West Brook, Moss Brook, Lake Mattawa, Orcutt Brook, Millers River
Phillipston	Beaver Brook
Royalston	Lawrence Brook, Tully Brook (E. Branch), Priest Brook, Scott Brook, Millers River
Warwick	Tully Brook, Moss Brook, Moore Pond, Mill Brook, Orcutt Brook, Sheomet Pond, Laurel Lake
Wendell	Osgood Brook
Westminster	Phillips Brook, Burnt Mill Pond Brook, Wyman Pond Brook, Crow Hill Pond
Winchendon	Millers River, Tarbell Brook, Lake Dennison, Priest Brook

3 - KEY FINDINGS

Introduction

Historic and current land use development patterns in the Millers River Watershed have altered the water quality and quantity of the mainstem and many of its tributaries. The individual and cumulative impacts of the construction and operation of dams, residential, commercial, and industrial water supply withdrawals, wastewater discharges, and land use changes have resulted in changes to the natural flow regime and water quality of the Millers River and its tributaries. Deviations from the natural timing, duration, magnitude and frequency of flows can affect riparian and aquatic resources as well as the quantity and quality of water available for human use.

Water Quantity[71]

Flow Regime

According to the findings presented in the April 2003 Hydrologic Assessment of the Millers River prepared by Gomez & Sullivan, opportunities exist to improve aquatic habitat in the Millers River Watershed by better management of river flow. Even modest modifications toward the natural flow regime (such as maintaining run-of-river operation, flushing flows, ramping rates, and seasonal minimum flows below dams) may result in vast improvements in aquatic habitat conditions in the Millers River. The key findings of the Gomez & Sullivan report are listed below:

- The operation of the two US Army Corps of Engineers' facilities (Birch Hill Dam and Tully Lake) has altered the natural timing, magnitude, frequency and rate of change of flow in the East Branch Tully River and the Millers River below South Royalston. The Corps and the U.S. Fish & Wildlife Service (USFWS) have been involved in on-going discussions concerning the operation of the Tully and Birch Hill Dam facilities. These discussions have addressed the concerns listed below as well as the magnitude of flow releases for pre-scheduled whitewater races. Changes to the natural flow regime documented by Gomez & Sullivan include:

    - Shifting the seasonal distribution and timing of naturally occurring fall and spring flows. The Corps reservoirs are drawn down in the fall in anticipation of the spring runoff. The drawdown/refill cycle has changed the timing and magnitude of flows over the fall and spring.

    - Changing the magnitude of low and high flows. The Corps facilities have significantly reduced the 1-, 3-, 7-, 30-, and 90-day annual maximum flow by storing large inflows. This is not surprising given

[71] The findings presented for the Water Quantity section were adapted from Gomez & Sullivan, op.cit.

that the purpose of the facilities is to reduce downstream flooding. The timing of the annual one-day maximum and minimum flow has also changed. Shifting the natural timing of high and low flows can affect the timing of certain life-cycle needs for various aquatic and riparian resources.

- The rate of change in flow. Gate changes can occur abruptly over a period of minutes. Discharges at these facilities can change abruptly over a few hours, which can directly affect aquatic resources below the facilities (similar to the effects described above for pulsing flows).

- Although the dams on the Millers River (except Birch Hill Dam) are required to be operated as run-of-river facilities (inflow instantaneously equals outflow), the hourly flow records reviewed by Gomez & Sullivan suggest otherwise. Pulsing flows were observed at the Millers River in Athol (50-60 cfs fluctuation each day) reflecting store-and-release type operations. At the New Home Dam in Orange, discharges have fluctuated up to 80 cfs, twice per day. Trout Unlimited, regulatory agencies and the dam owners are working to resolve this issue. Pulsing flows, depending on the magnitude of flow fluctuation, can have significant impacts on aquatic resources by causing fish and macroinvertebrate stranding, by reducing available aquatic habitat, and by affecting spawning grounds.

- Flushing flows are deliberate high flow releases of short duration designed to mimic the effects of natural floods. The purpose of these high flow releases is to remove fine sediment accumulated on the bed (especially in spawning gravels), to maintain fish spawning and rearing habitat, and to maintain channel conveyance capacity. The Tully and Birch Hill Dam facilities were developed to reduce natural floods; however, there are instances when discharges are deliberately increased for the special whitewater events such as the River Rat race. It is unknown if these special discharges are sufficient to remove fine sediments from spawning gravels.

Dams

According the Gomez & Sullivan report, there are at least 197 dams in the Millers River Watershed. Many of the dams are probably abandoned and/or serving no useful purpose. The potential environmental benefits/impacts of removing these dams should be given careful consideration.

Fish Passage

The Millers River Watershed lies within the larger Connecticut River Watershed which has been the focus of a long-term effort to restore Atlantic salmon. As part of this restoration effort, a reach of the Millers River, between South Royalston and Athol, is stocked with salmon fry. After spending 2-3 years in freshwater, these salmon (now called smolts) migrate downstream in the Spring to the ocean. Between the stocking

location and the confluence with the Connecticut River there are four dams on the Millers River. Smolts that migrate downstream in the Spring have passage at three of the four dams. The efficiency of these downstream passage facilities for passing smolts is unknown. Currently, adult salmon have upstream passage by several dams on the Connecticut River to its confluence with the Millers River. To date, the USFWS has not mandated upstream passage facilities for migrating adult salmon for dams on the Millers River.

Water Budget

As described in the Gomez & Sullivan report, the water budget for the watershed is that inflow approximates outflow. In other words, most of the water withdrawn from the aquifers and surface waters of the Millers River Watershed is returned to the watershed via wastewater treatment facilities or septic systems. Therefore, there is only a minor loss of water from the watershed (primarily in Ashburnham which straddles the boundary between the Nashua and Millers watersheds).

The state has two metrics which are used to evaluate the water conservation efforts of municipal public water supplies: 1) limit residential water use to 70-80 gallons per capita per day (gpcd); and, 2) limit unaccounted for water (UAW) to 10%-15% of the total water supply.[72] According to the data evaluated by Gomez & Sullivan, five (5) out of the six (6) public water suppliers in the Millers River Watershed exceeded the 10% UAW metric at some point in the last three years. In most cases, water suppliers explained that the high UAW was due to leaks, fire flow, etc. All water suppliers reported residential water usage below the 80 gpcd metric.

Estimates of future residential water demands indicate that the current total withdrawal of 5.28 million gallons per day (mgd) from existing public water supplies will increase to 6.25 mgd by 2020. This figure does not include existing or future industrial use demands or existing or future private wells. To meet future water demands, towns may have to consider a range of alternatives, including implementing aggressive water conservation measures, increasing withdrawals from existing sources, bringing new water supplies on-line. The environmental impacts of these increased water withdrawals are not known and would require careful evaluation.

Stressed Basins

If a watershed is experiencing hydrologic stress, it is likely that water quality and habitat areas will also be exhibiting signs of stress. Adequate streamflow is a basic requirement to maintain streamflow quality and the availability and quality of habitat. The hydrologic stress classifications for the Millers River Watershed are defined as the relative strength of the watershed's rivers in relation to other rivers in Massachusetts. The stress levels reported for the Millers River Watershed and several tributaries are shown in Table 3-1. The stress levels for several subwatersheds are shown in Table 3-2. This information can be used to evaluate the potential environmental impacts of proposed future water

[72] Gomez & Sullivan, op.cit.

withdrawals and/or large development projects that would significantly alter subwatershed hydrology.

Table 3-1
Stress Classifications for the Millers River Watershed[73]

USGS Station Number	Gage Name	Final Stress Level
01165000	East Branch Tully River near Athol	HIGH
01162500	Priest Brook near Winchendon	HIGH
01166500	Millers River at Erving	MEDIUM
01164000	Millers River at South Royalston	MEDIUM
01162000	Millers River near Winchendon	MEDIUM
01161500	Tarbell Brook near Winchendon	MEDIUM
01163200	Otter River at Otter River	MEDIUM*

**Data for the Otter River indicates a low stress classification but it is classified at medium stress due to a medium stress classification downgradient.*

Table 3-2
Stress Level Summary for Selected Subwatersheds[74]

Subwatershed	Drainage Area (square miles)	Water Resources Commission's - Method Stress Classification
Otter River	60.54	MEDIUM
Upper Naukeag Lake	1.90	HIGH
Tully River	74.0	LOW
North Pond Brook	1.98	MEDIUM
Millers River	388.87	LOW

[73] Table adapted from Gomez & Sullivan, op.cit.
[74] Table adapted from Gomez & Sullivan, op.cit.

Aquifers

There are several high-yield aquifers (>200 gallons per minute) within the watershed, including the North Pond Brook aquifer, which supplies drinking water to Orange, the Tully River aquifer, which supplies drinking water to Athol, and the high-yield aquifers in Montague and around Kendall Pond in Gardner and Templeton. The largest high-yield aquifer in the watershed is the one that trends in a north/south direction from Winchendon, through Lake Dennison, and into Templeton. As discussed in following sections of this chapter (Wildlife Habitat and Biodiversity, Land Use and Growth), much of the land overlying these aquifers and/or contributing recharge to these aquifers is not permanently protected from development. In fact, land overlying several of these sensitive aquifers and recharge areas has experienced significant development since 1971.

Water Quality

The extensive inventory of potential sources of nonpoint pollution in the Millers River Watershed and Action Items compiled as part of the report prepared by the Montachusett Regional Planning Commission and the Franklin Regional Council of Governments in 2002 is a valuable planning tool for those involved in growth management and resource and land protection efforts in the watershed. The inventory should be updated and the Action Items revisited and re-prioritized. Of particular note, however, are the potential environmental threats posed by the fourteen (14) landfills and fifty-two (52) other waste sites in the watershed and the numerous sand and gravel operations in the watershed. At this point, funding is needed to undertake an assessment of these sites so that the need for mitigative measures can be prioritized and implemented. A similar project to inventory and assess the landfills was successfully conducted in the Deerfield River Watershed.

The Massachusetts Department of Environmental Protection (MA DEP) presented a summary of water quality conditions in the Millers River Watershed in the 2000 Water Quality Assessment Report. The findings of that report are based on water quality data collected by the MA DEP and others to assess the designated uses for the rivers, lakes and ponds in the watershed. These uses were discussed in more detail in Chapter 2 of this Watershed Action Plan.

Table 3-3 illustrates the status of the major tributaries and the mainstem for meeting criteria or guidance for the Aquatic Life Use and the Recreation and Aesthetics Use. If the criteria or guidance were met for the particular use, this is indicated by green shading, where the criteria or guidance were not met, red shading is used. Issues of concern are identified by yellow shading. The grey shading indicates that no or insufficient data were available. The cross hatching indicates that very limited data were available. Table 3-4 illustrates the status of the lakes and ponds which were assessed by the MA DEP. Like Table 3-3, if the criteria or guidance were met for the particular use, this is indicated by green shading, where the criteria or guidance were not met, red shading is used. Issues of concern are identified by yellow shading. The grey shading indicates that no or insufficient data were available.

These tables are useful planning tools and can be used to identify additional monitoring needs or where additional information gathering is warranted. These tables are also valuable in identifying areas where mitigative actions could be taken to improve water quality.

Rivers

The MA DEP presented the following conclusions in their 2000 Water Quality Assessment Report for the Millers River and its main tributaries.[75]

- A fish advisory is in effect for the Millers River and its tributaries. Elevated levels of PCBs and/or mercury were detected in the tissue of fish collected from certain segments of the Millers River and the Otter River but no testing of fish from other tributaries has been conducted.

- Sediments in the Otter River and the Millers River downstream from the confluence with the Otter River are contaminated with PCBs.

- The alteration of the natural flow regime, and ultimately its effects on instream habitat and biological integrity, in the Millers River and several tributaries is of concern. There are numerous activities that affect the timing, magnitude, frequency, and rate of change of natural flows including, but not limited to, the operation of flood control projects, hydropower operation(s) and outlet control practices at dams.

- More data were available for the Millers River mainstem and the Otter River than for the other tributaries to the Millers River.

- The Otter River stands out as having multiple water quality problems.

- There is a lack of bacteriological data throughout the watershed which limits the assessment of recreational uses.

Lakes

The MA DEP presented the following key findings for lakes in the Millers River Watershed.[76]

- Eight (8) of the sixty-five (65) lakes in the watershed were assessed as **Impaired** for the *Aquatic Life Use*. None of the other lakes were assessed. The cause of impairment was typically infestation by non-native plants. The three non-native aquatic species documented in the Millers River Watershed lakes are: *Myriophyllum heterophyllum* (variable water milfoil), *M. spicatum* (Eurasian water milfoil) and *Cabomba caroliniana* (fanwort). These species have a high potential for spreading and are likely to have established themselves in

[75] Kennedy and Rojko, op.cit.
[76] Kennedy and Rojko, op.cit.

downstream lake and river segments in the watershed that have not been surveyed. Figure 3-1 indicates the infested lakes and potential avenues of downstream spreading.

- Eight (8) lakes were **Impaired** for the *Fish Consumption Use* due to mercury contamination.

- Five (5) lakes were assessed as **Support** for the *Primary and Secondary Contact Recreational* and *Aesthetic Uses*.

- A total of forty-eight (48) lakes (1,581.9 out of 3,994 acres) were **Not Assessed** for any uses due to a lack of adequate data.

- Upper Naukeag Lake was identified as a **High Stress** level subwatershed because some of the water withdrawn from the lake is transferred out of the Upper Millers River subwatershed to the Otter River subwatershed, the Middle Millers River subwatershed and the Nashua River Watershed.

Other Issues

The MA DEP also provided the following additional input on Watershed Action Plan issues, including:[77]

- Acid deposition is impacting the watershed, particularly in the tributaries which show low pH and alkalinities.

- Local officials need information on issues of specific concern (sand and gravel operations, underground storage tanks, solid waste dumping, stormwater, etc.) so that they can make informed decisions.

- Communities should ensure that individual on-site septic systems are properly sited, maintained, and inspected.

- MA DEP should continue its long-term, fixed site monitoring at the five established sites in the watershed.

- The Millers River Environmental Center and the Otter and Tully River Stream Teams should continue to monitor water quality conditions in the watershed.

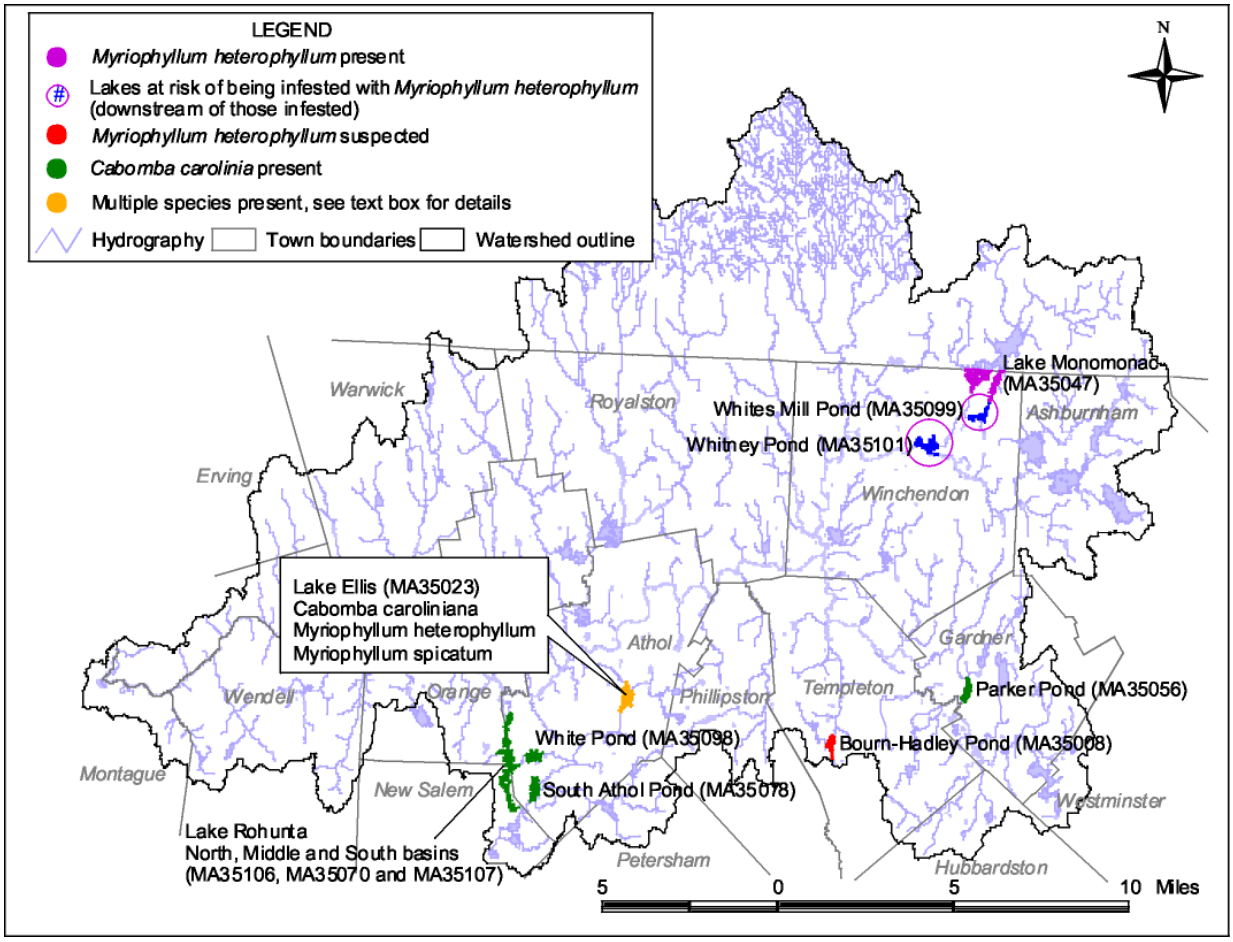
- MA DEP should continue to evaluate and reissue the NPDES permits with appropriate limits and monitoring requirements.

- Continue to integrate the key findings and recommendations of previous studies completed for the watershed (MA DEP's Non-point Source Strategy, the 2002 Non-point Source Assessment Report, the MA DEP's 2000 Water Quality Assessment Report).

[77] Alice Rojko and Warren Kimball, MA DEP, written communication, 2004.

Figure 3-1

Millers River Watershed Lakes – Presence of Non-native Aquatic Vegetation and Potential for Downstream Spreading[78]



[78] Figure courtesy of Kennedy and Rojko, op.cit.

Table 3-3 Summary of Water Quality Indicators - Rivers[79]

Water Body (Segment)	Aquatic Life							Recreation & Aesthetics		Fish Tissue*	
		Water Quality									
	Biology	Chemistry	Nutrients	Toxicity	Sediments	Flow	Habitat	Bacteria	Aesthetics	Hg	PCBs
MILLERS RIVER – MAINSTEM											
Sunset Lake to Whitney Pond (MA35-20)											
Whitney Pond to Winchendon WWTF (MA35-01)											
Winchendon WWTF to confluence with Otter River (MA35-02)											
Confluence of Otter River to South Royalston USGS Gage (MA35-03)											
South Royalston USGS Gage to Upper Cresticon Dam (MA35-04)											
Upper Cresticon Dam to Erving Center WWTF (MA35-04)											
Erving Center WWTF to confluence with Connecticut River (MA35-05)											
OTTER RIVER SUBWATERSHED											
Source in Hubbardston to Gardner WWTP (MA35-06)											
Gardner WWTP to Seaman Paper Dam (MA35-07)											
Seaman Paper Dam to Confluence with Millers River (MA35-08)											
TULLY RIVER SUBWATERSHED											
East Branch Tully River (MA35-12)											
Boyce Brook (MA35-17)											
Lawrence Brook (MA35-13)											
West Branch Tully River (MA 35-11)											

[79] Table adapted from Kennedy and Rojko, op.cit.

Water Body (Segment)	Aquatic Life							Recreation & Aesthetics		Fish Tissue*	
		Water Quality									
	Biology	Chemistry	Nutrients	Toxicity	Sediments	Flow	Habitat	Bacteria	Aesthetics	Hg	PCBs
Tully River (MA 35-14)											
OTHER TRIBUTARIES											
North Branch Millers River (MA35-21)											
Priest Brook (MA35-10)											
Beaver Brook (MA35-09)											
Whetstone Brook (MA35-18)											
Keyup Brook (MA 35-16)											
Mormon Hollow Brook (MA35-15)											
Lyons Brook (MA35-19)											
Tarbell Brook											
West Brook											
Lake Rohunta											
Moss Brook											

Criteria/guidance met
Concerns identified
Criteria/guidance not met
No/Insufficient data available
Very limited data available.

*Results presented are based on actual Fish Tissue Data that were collected and not the MA DPH Fish Consumption Advisory

Table 3-4 Millers River Watershed Lake Assessments[80]

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Bassett Pond, New Salem.	MA35002	26	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Beaver Flowage Pond (Beaver Pond), Royalston.	MA35005	38	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Bents Pond, Hubbardston.	MA35006	29	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Bents Pond, Gardner.	MA35007	6	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Bourn-Hadley Pond, Templeton.	MA35008	26	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Bowens Pond, Wendell.	MA35009	17	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Brazell Pond, Templeton.	MA35010	15	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Cowee Pond, Gardner.	MA35013	18	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Crystal Lake, Gardner.	MA35014	142	NOT ASSESSED Alert Status	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Note: Crystal Lake is a Class A, Public Water Supply. Gardner Water Department has a surface water intake in Crystal Lake (WMA permit/permit 20710301/9P220710302). The City of Gardner Surface Water Supply Protection Plan for Crystal Lake was completed in October 2002. A discharge from the Gardner Water Treatment Facility is authorized (MAG640041) to the lake. Because of high aluminum concentrations in WTF discharge, the *Aquatic Life Use* is identified with an Alert Status. The MRPC and FRCOG 2002 study note the Gardner Municipal Golf Course is located on Eaton Street adjacent to Crystal Lake.							
Davenport Pond, Athol/Petersham.	MA35015	30	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

[80] Table adapted from Kennedy and Rojko, op.cit.

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Depot Pond (Railroad Pond), Templeton.	MA35018	15	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Dunn Pond, Gardner.	MA35021	18	NOT ASSESSED	NOT ASSESSED	SUPPORT	SUPPORT	SUPPORT
Note: Dunn Pond DCR State Park in Gardner has a public bathing beach. This beach was posted for a 3-day period in July 2001 because of elevated bacteria and no postings were recorded for the 2002 swimming season. Because the beach was open for the majority of the 2001 and 2002 bathing seasons, the *Recreational* and Aesthetic uses are assessed as support.							
East Templeton Pond, Templeton.	MA35022	9	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Ellis Pond (Lake Ellis), Athol.	MA35023	68.9	IMPAIRED (Non-native aquatic plants– *Myriophyllum heterophyllum, M. spicatum, Cabomba caroliniana*)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Note: Ellis Pond is a Class A, Public Water Supply. A diagnostic/feasibility study for lake is available documenting both *M. heterophyllum* and *M. spicatum*. Town received DCR Lakes and Ponds Grant (2000) to control the spread of the non-native nuisance aquatic plant, Fanwort, with the use of herbicides; an educational brochure on in-lake and watershed best management practices was also included. *Eichhornia crassipes* (water hyacinth), a non-native tropical aquatic plant not capable of overwintering, was also observed in this lake in 1995. The MRPC and FRCOG 2002 report indicated the golf course at Ellinwood Country Club in Athol is in close proximity to Lake Ellis and surrounding wetland and floodplain areas.							
Gales Pond, Warwick.	MA35024	12	NOT ASSESSED	IMPAIRED (Mercury)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Fish toxics monitoring for PCBss, organochlorine pesticides and selected metals (including Hg, As, Se, Pb, and Cd) was conducted in Gales Pond as part of DEP ORS R&D study in 1994. Because of elevated mercury, MA DPH issued a fish consumption advisory recommending "Children younger than 12 years, pregnant women, and nursing mothers should not eat any yellow perch from this waterbody and the general public should limit consumption of yellow perch from this waterbody to two meals per month." Because of the site-specific advisory the *Fish Consumption Use* is assessed as impaired.							
Greenwood Pond, Westminster.	MA35025	27	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Greenwood Pond, Templeton.	MA35026	12	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Hastings Pond, Warwick.	MA35028	18	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Hilchey Pond, Gardner.	MA35029	8	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Kendall Pond, Gardner.	MA35034	22	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED Alert Status	NOT ASSESSED	NOT ASSESSED
Note: A diagnostic/feasibility study for pond is available. Kendall Pond has a public bathing beach. Although no beach postings were reported, elevated bacteria counts were documented and therefore the *Primary Contact Recreational Use* is identified with an Alert Status. Town received DCR Lake and Pond Grant (1995, 1997, 2001) to control nuisance, native plants (Bladderwort and Milfoil) with an herbicide because of an increasing problem for recreational users. A sanitary sewer project was completed in 1999 for sewering the homes around the pond.							
Lake Dennison, Winchendon.	MA35017	84	NOT ASSESSED Alert Status	IMPAIRED (Mercury)	SUPPORT	SUPPORT	SUPPORT
The fish population in Lake Dennison (MA DFWELE sampling in September 2000) was dominated by white sucker, yellow perch and largemouth bass. Total PCBs concentrations in 'whole fish' samples (sampling conducted in October 1999) exceeded the NAS/NAE guideline of by a factor of 2.0 to 2.5 times (data reported in ENSR 2000). Surficial sediment screening samples collected in August 1999 at three sites in the deep hole, total PCBs concentrations <2ppm. Because of the elevated PCBs in 'whole fish' which exceeded the NAS/NAE guidelines, the *Aquatic Life Use* is identified with an Alert Status.							
Total PCB concentrations in the edible fillets (sampling conducted in September 1999) did not exceed the MA DPH guideline of 1.0 ppm. Fish toxics monitoring was conducted by DEP in Lake Dennison in August 1995 and June 1996. Because of elevated mercury concentrations, MA DPH issued a Fish Consumption Advisory recommending that "Children younger than 12 years, pregnant women, and nursing mothers should not eat any largemouth bass from this waterbody, and the general public should limit consumption of largemouth bass from this waterbody to two meals per month." Therefore the *Fish Consumption Use* is assessed as impaired Lake Dennison is on the 1998 303(d) list of impaired waters because of organic enrichment/low DO.							
Lake Dennison has a public access site as well as a public bathing beach (Lake Dennison State Recreational Area in the Otter River State Park in Winchendon). No beach closures have been reported and therefore the *Recreational* and *Aesthetic* uses are assessed as support.							
The MRPC and FRCOG 2002 report noted underground storage tanks, sand and gravel operations and stormwater as potential nonpoint sources of pollution.							
Lake Mattawa (North Pond Brook Reservoir), Orange	MA35112	112	NOT ASSESSED	NOT ASSESSED	SUPPORT	SUPPORT	SUPPORT
Note: Lake Mattawa is a Class A , Public Water Supply. This lake's southern outlet drains to the Quabbin Reservoir on occasion). Lake Mattawa has a public bathing beach. No beach closures have been reported (Town of Orange 2002) and, therefore, the *Recreational* and *Aesthetic* uses are assessed as support.							

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Lake Monomonac, Winchendon/Rindge,NH MA portion only.	MA35047	188	IMPAIRED (Non-native plants – *M. heterophyllum*)	NOT ASSESSED Alert Status	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Lake Monomonac was treated with Diquat in 2000 (DCR Lake and Pond Grant to town) and June 2002 to control the spread of the non-native aquatic plant *M. heterophyllum* (Variable water milfoil). A minimum drawdown determination study is also available as an option to control the nuisance aquatic plant problem. Septic system problems and stormwater from road drainage were identified as potential nonpoint source areas of concern in the MRPC and FRCOG 2002 study.							
Although no site-specific advisory for fish consumption use, NH DES does indicate elevated mercury in fish tissue therefore the *Fish Consumption Use* is identified with an Alert Status.							
Lake Rohunta (Middle Basin), Athol/Orange/New Salem.	MA35070	209	IMPAIRED (Non-native plants – *Cabomba caroliniana*)	IMPAIRED (Mercury)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Lake Rohunta is infested with the non-native aquatic species *Cabomba caroliniana* and, therefore, the *Aquatic Life Use* is assessed as impaired. Largemouth bass and golden shiner dominated the population (sampling conducted by MA DFWELE in August 2000). Fish toxics monitoring was conducted by DEP in July 1995. Because of elevated mercury in fish tissue the MA DPH issued a Fish Consumption Advisory recommending "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this water body and the general public should limit consumption of all fish from this water body to two meals per month." Since there is a site specific advisory, the *Fish Consumption Use* is assessed as impaired. Lake Rohunta has a public access site.							
Lake Rohunta (North Basin), Athol/Orange.	MA35106	34	IMPAIRED (Non-native plants – *Cabomba caroliniana*)	IMPAIRED (Mercury)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Lake Rohunta is infested with the non-native aquatic species *Cabomba caroliniana* and, therefore, the *Aquatic Life Use* is assessed as impaired. MA DPH Fish Consumption Advisory recommends "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this water body and the general public should limit consumption of all fish from this water body to two meals per month." Since there is a site specific advisory, the *Fish Consumption Use* is assessed as impaired. Lake Rohunta has a public access site.							
Lake Rohunta (South Basin), New Salem.	MA35107	42	IMPAIRED (Non-native plants – *Cabomba caroliniana*)	IMPAIRED (Mercury)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Lake Rohunta is infested with the non-native aquatic species *Cabomba caroliniana* and, therefore, the *Aquatic Life Use* is assessed as impaired. The non-native wetland species, *Phragmites australis*, was observed at Lake Rohunta (South Basin), in the summer of 1995. MA DPH Fish Consumption Advisory recommends "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this water body and the general public should limit consumption of all fish from this water body to two meals per month." Since there is a site specific advisory, the *Fish Consumption Use* is assessed as impaired. Lake Rohunta has a public access site. Lake Rohunta is on the 1998 303(d) list of impaired waters because of noxious aquatic plants.							
Lake Watatic, Ashburnham	MA35095	133	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Table 2-5 Millers River Watershed Lake Assessments (continued)

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Laurel Lake, Erving/Warwick.	MA35035	44	NOT ASSESSED	NOT ASSESSED	SUPPORT	SUPPORT	SUPPORT
Note: Fish toxics monitoring for PCBss, organochlorine pesticides and selected metals (including Hg, As, Se, Pb, and Cd) was conducted in Laurel Lake as part of DEP ORS R&D study in 1994. Since no advisory was issued, the *Fish Consumption Use* is not assessed							
Laurel Lake has a public access site and there is a public bathing beach on Laurel Lake in the Erving Forest State Park in Warwick. No beach closures have been reported and, therefore, the *Recreational* and *Aesthetic* uses are assessed as support.							
Little Pond, Royalston.	MA35037	18	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Lower Naukeag Lake, Ashburnham.	MA35041	295	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Lake has been treated with Diquat between 1992 and 2001 to control very dense growths of aquatic macrophytes (TMDL report). The MRPC and FRCOG 2002 report identified unpaved roads near Lower Naukeag Lake as a potential nonpoint source of pollution.							
Minott Pond, Westminster.	MA35046	8	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Minott Pond is on the 1998 303(d) list of impaired waters because of noxious aquatic plants. The TMDL of Phosphorus for this pond is to be reduced from the current estimated loading of 44 kg/year to a target load of 40 kg/year (9% reduction).							
Minott Pond South, Westminster.	MA35045	27	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Moores Pond, Warwick.	MA35048	39	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
North Spectacle Pond, New Salem.	MA35052	43	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Packard Pond, Orange.	MA35053	43	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
The MRPC and FRCOG 2002 report noted septic system concerns at Packard Pond.							

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Parker Pond, Gardner.	MA35056	32	IMPAIRED (Non-native plants – *Cabomba caroliniana*)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Note: Parker Pond is infested with the non-native aquatic species *Cabomba caroliniana* and, therefore, the *Aquatic Life Use* is assessed as impaired. The city was granted a DCR Lake and Pond Grant (1996) for Phase I of a restoration project, which included watershed and in-lake evaluation, analysis of alternatives and a management program. The *Parker Pond Restoration, Gardner* project is currently underway which should be completed by June 2004. A report on alternatives for aquatic habitat restoration is being prepared by the USACE, New England District. Sedimentation and encroaching vegetation has reduced and degraded fish habitat and a plan to excavate 178,000 cubic yards of sediment has been proposed but is on hold until a disposal site is identified.							
Partridgeville Pond, Templeton.	MA35057	38	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Perley Brook Reservoir, Gardner.	MA35059	55	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Phillipston Reservoir, Athol/Phillipston.	MA35060	20	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Note: Phillipston Reservoir is a Class A, Public Water Supply. Athol Water Department had a surface water intake in Phillipston Reservoir (WMA registration 20701501). This source has been abandoned.							
Ramsdall Pond, Gardner.	MA35062	2	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Reservoir #1, Athol.	MA35063	8	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Note: Reservoir #1 is a Class A , Public Water Supply.							
Reservoir #2 (Secret Lake), Athol/Phillipston.	MA35064	48	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Note: Reservoir #2 is a Class A , Public Water Supply.							
Riceville Pond, Athol/Petersham.	MA35065	61	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Richards Reservoir, Warwick.	MA35067	21	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Royalston Road Pond, Orange.	MA35071	10	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Ruggles Pond, Wendell.	MA35072	15	NOT ASSESSED	NOT ASSESSED	SUPPORT	SUPPORT	SUPPORT
Note: There is a public bathing beach at Ruggles Pond in the Wendell State Forest in Wendell. No beach closures have been reported and, therefore, the *Recreational* and *Aesthetic* uses are assessed as support. The MRPC and FRCOG 2002 report noted a sand and gravel operation is located in the southern portion of Lyons Brook near Ruggles Pond.							
Sheomet Lake, Warwick.	MA35074	31	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Note: Fish toxics monitoring for PCBss, organochlorine pesticides and selected metals (including Hg, As, Se, Pb, and Cd) was conducted in Sheomet Lake as part of DEP ORS R&D study in 1994. Since no site-specific advisory was issued, the *Fish Consumption Use* is not assessed.							
South Athol Pond, Athol.	MA35078	83	IMPAIRED (Non-native plants – *Cabomba caroliniana*)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
South Athol Pond is infested with the non-native aquatic species *Cabomba caroliniana* and, therefore, the *Aquatic Life Use* is assessed as impaired.							
South Spectacle Pond, New Salem.	MA35081	38	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Sportsmans Pond, Athol.	MA35082	93	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Stoddard Pond, Winchendon.	MA35083	52	NOT ASSESSED Alert Status	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
NOTE: TMDL survey conducted in 2000 and synoptic survey in 1995. This pond had low dissolved oxygen/saturation at depths below 1.0m, low pH and alkalinity, and high color . These data are likely indicative of natural conditions associated with the wetlands upstream. While there are low to moderate levels of total phosphorus in the pond (concentrations ranging between 0.024 to 0.037mg/L), they did not result in high lake productivity (i.e., low to moderate chlorophyll *a* concentrations). Biovolume density estimated as 85% dense/very dense cover and no non-native aquatic plants were identified. The fish population was dominated by yellow perch. The *Aquatic Life Use* is identified with an Alert Status, however because it is undetermined if the phosphorus concentrations were elevated as a result of anthropogenic sources. The Secchi disc depths ranged from 1.4 to >1.8 m (meeting the bathing beach guidelines) even though the water was colored. No fecal coliform bacteria data are currently available and therefore the *Primary* and *Secondary Contact Recreationa*l uses are currently not assessed. There is no public bathing beach on the pond.							
Sunset Lake, Ashburnham/ Winchendon	MA35086	274	NOT ASSESSED Alert Status	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
NOTE: Unconfirmed report of a non-native aquatic species (*Myriophyllum heterophyllum*) needs confirmation, however the *Aquatic Life Use* is identified with an Alert Status. This lake has been treated because of nuisance aquatic plants. The MRPC and FRCOG 2002 report identified unpaved roads near Sunset Lake and its tributaries as a potential nonpoint pollution source.							
Travers Pond, Gardner.	MA35088	4	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Tully Lake, Royalston.	MA35111	214	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
The USACE New England District maintains a flood control project, Tully Lake in the town of Royalston. Tully Dam is a Class II project (i.e., minor or suspect water quality problems), which is part of a system of two USACE flood control dams in the Millers River Basin. Yellow perch and largemouth bass dominated the fish population (sampling conducted by MA DFWELE in August 2000). Although Tully Lake has no official swimming area, the USACE did monitor *E. coli* bacteria weekly at one station in the lake. No "closures" were reported in 2002 - 2003.							
Tully Pond, Orange.	MA35089	70	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
The MRPC and FRCOG 2002 report noted septic system concerns around Tully Pond.							

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Upper Naukeag Lake, Ashburnham.	MA35090	305	NOT ASSESSED Alert Status	IMPAIRED (Mercury)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Note: Upper Naukeag Lake is a Class A, Public Water Supply. Both Ashburnham and Winchendon Water Departments are registered to withdraw water from Upper Naukeag Lake (0.18 and 0.67 MGD, respectively); additional information is provided in the Millers River segment MA35-20. Using criteria set forth by the Massachusetts Water Resource Commission, Upper Naukeag Lake, with a watershed drainage area of 1.90 mi2, was identified at a high stress level based on water quantity (Gomez & Sullivan). Because of the water withdrawals, the *Aquatic Life Use* is identified with an Alert Status.							
A discharge from the Ashburnham & Winchendon Water Treatment Plant (WTP) is authorized (MAG640045) to the lake. Fish toxics monitoring for PCBss, organochlorine pesticides and selected metals (including Hg, As, Se, Pb, and Cd) was conducted in Upper Naukeag Lake as part of DEP ORS R&D study in 1994. Because of elevated mercury levels MA DPH recommends "Children younger than 12 years, pregnant women, and nursing mothers should not eat any smallmouth bass or yellow perch from this waterbody and the general public should limit consumption of smallmouth bass or yellow perch from this waterbody to two meals per month." Because of the site-specific advisory, the *Fish Consumption Use* is assessed as impaired.							
Upper Reservoir, Westminster.	MA35091	42	NOT ASSESSED	IMPAIRED (Mercury)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Fish toxics monitoring for PCBss, organochlorine pesticides and selected metals (including Hg, As, Se, Pb, and Cd) was conducted in Upper Reservoir as part of DEP ORS R&D study in 1994 . Because of elevated mercury levels MA DPH recommends "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this water body and the general public should limit consumption of all fish from this water body to two meals per month." Because of the site-specific advisory, the *Fish Consumption Use* is assessed as impaired. Upper Reservoir was sampled again in 2001 and 2002; mercury concentrations in largemouth bass and yellow perch all exceeded the MA DPH action level. Upper Reservoir will continue to be sampled as part of an ongoing long-term study being conducted by DEP ORS.							
Wallace Pond, Ashburnham.	MA35092	46	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Note: Observations by DWM indicated possible trap and skeet facility/sportsman club near the pond. This should be investigated further to determine if it is active or not and whether or not lead shot is a concern.							
Ward Pond, Athol.	MA35093	6	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

Table 2-5 Millers River Watershed Lake Assessments (continued)

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Wheelers Pond, Warwick.	MA35097	28	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
White Pond, Athol.	MA35098	63	IMPAIRED (Non-native plants – *Cabomba caroliniana*)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
NOTE: White Pond is infested with the non-native aquatic species *Cabomba caroliniana* and, therefore, the *Aquatic Life Use* is assessed as impaired. The MRPC and FRCOG 2002 study noted septic system concerns around White Pond.							
Whites Mill Pond, Winchendon.	MA35099	42	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
The MRPC and FRCOG 2002 report identified a sand and gravel operation in the vicinity of Whites Mill Pond as potential nonpoint pollution source.							
Whitney Pond, Winchendon.	MA35101	107	ALERT STATUS	IMPAIRED (Mercury) (274)	NOT ASSESSED	NOT ASSESSED	ALERT STATUS (Non-native plants – *Lythrum salicaria*)
NOTE: TMDL survey conducted in 2000 and synoptic survey in 1995. This pond had low dissolved oxygen/saturation at depths below 1.0m, low pH and alkalinity, and high color. These data are likely indicative of natural conditions associated with the wetlands upstream. While there are moderate levels of total phosphorus at the surface (concentrations ranging between 0.034 to 0.045mg/L) and high concentrations near the lake bottom (ranging from 0.057 to 0.092 mg/L), they did not result in high lake productivity (i.e., low to moderate chlorophyll *a* concentrations). Biovolume density estimated as 37% dense/very dense cover and no non-native aquatic plants were identified. The *Aquatic Life Use* is identified with an Alert Status, however because it is undetermined if the phosphorus concentrations were elevated as a result of anthropogenic sources. The *Aesthetics Use* is currently not assessed, however, the presence of a non-native wetlands species (*Lythrum salicaria*) was identified. Whitney Pond is on the 1998 303(d) list of impaired waters because of metals, noxious aquatic plants, and turbidity. The TMDL of Phosphorus for this pond is to be reduced from the current estimated loading of 1918 kg/year to a target load of 1552 kg/year (19% reduction). Fish toxics monitoring was conducted in this pond in 1987.							
The MRPC and FRCOG 2002 study noted stormwater concern along High Street. Additionally the Winchendon Country Club with a golf course is in close proximity. Fish toxics monitoring was conducted by DEP in Whitney Pond in 1987. Mercury exceeded the MA DPH action level of 0.5 mg/kg. The current MA DPH advisory for the Millers River (all towns from Erving to Winchendon) (which includes Whitney Pond) recommends "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this waterbody and its tributaries, the general public should not consume any brown trout or American eel taken from this waterbody downstream from its confluence with the Otter River, and the general public should limit consumption of all non-affected fish from this waterbody and its tributaries to two meals per month" because of mercury and PCBss. However, PCBs levels in fish from Whitney Pond did not exceed the MA DPH action level of 1.0 mg/Kg. The MA DPH is currently in the process of reevaluating the advisory for the Millers River Watershed. The *Fish Consumption Use* is assessed as impaired because of the existing site-specific advisory, however, the cause of impairment is limited to mercury							

Table 2-5 Millers River Watershed Lake Assessments (continued)

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Wickett Pond, Wendell.	MA35102	32	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Wrights Reservoir, Gardner/Westminster.	MA35104	128	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Wrights Reservoir is on the 1998 303(d) list of impaired waters because of noxious aquatic plants. After reevaluating information it was determined that the conditions in this pond were likely naturally occurring. Further corroborating this evaluation, the TMDL of Phosphorus for Wrights Reservoir is to maintain its current estimated loading of 157 kg/year.							

Wildlife Habitat & Biodiversity

The BioMap and Living Waters projects undertaken by the Natural Heritage and Endangered Species Program (NHESP) identify the critical areas in the state in need of protection in order to preserve native biodiversity. NHESP developed maps to delineate the most viable aquatic and terrestrial rare species habitats and natural communities, called Core Habitat, as well as large, minimally-fragmented areas of Supporting Natural Landscapes and Critical Supporting Watersheds that protect the Core BioMap and Living Waters Habitats.

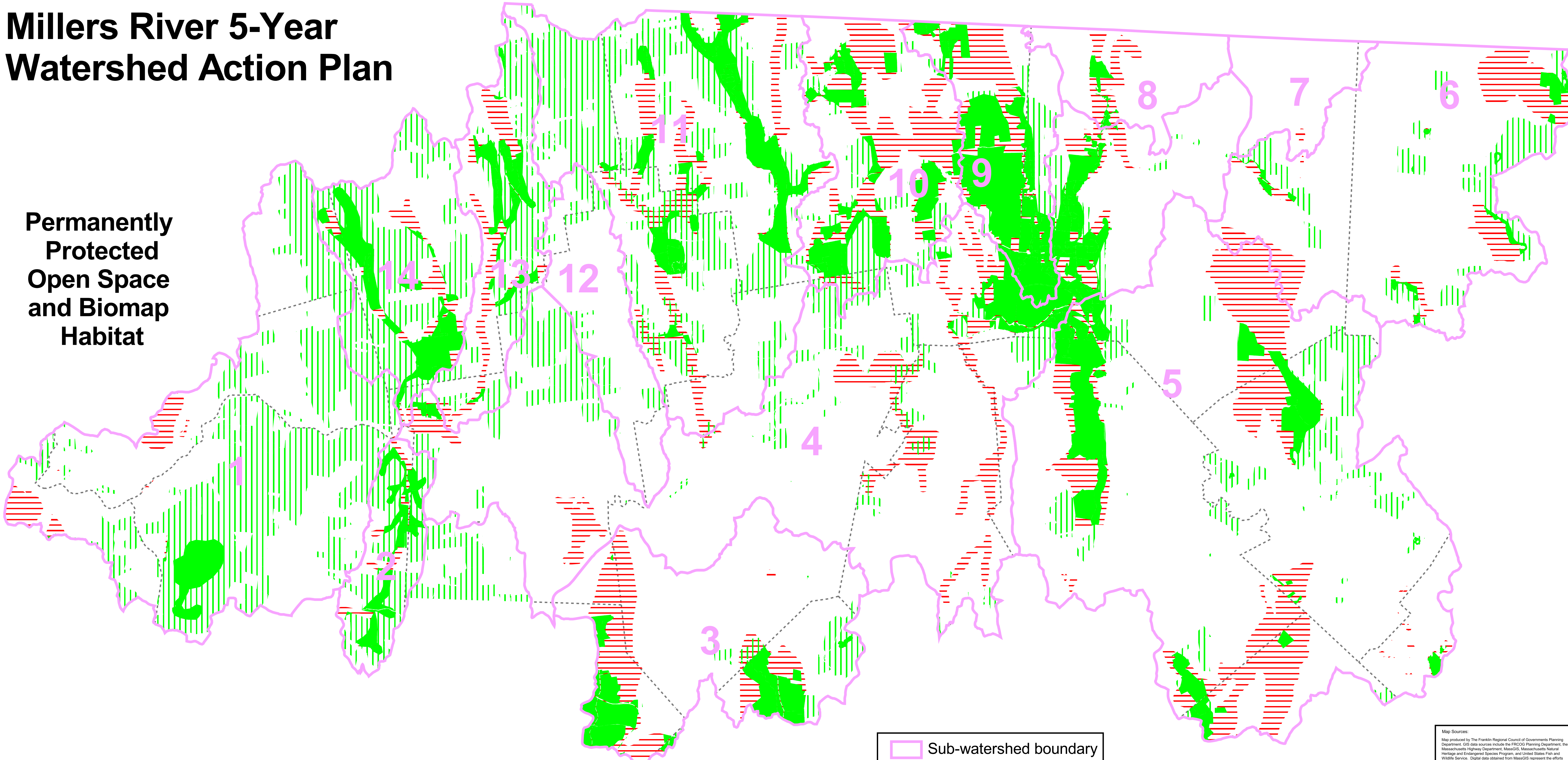
There are several significant areas of Core Habitats and Supporting Natural Landscapes and Critical Supporting Watersheds in the Millers River Watershed. In the western and north-central portions of the watershed large tracts of core habitat and supporting lands have been permanently protected from development. Of the approximately 39,920 acres of BioMap Core Habitat in the Millers River Watershed, approximately 17,360 acres are permanently protected (43%). However, large tracts of this vital habitat remain vulnerable to development, especially in the eastern and south-central part of the watershed where there is a limited amount of permanently protected open space.[81] There are other resources that coincide with the core habitat areas, including potential vernal pools and high-yield aquifers (>200 gallons per minute) and the watershed lands surrounding these aquifers. Protecting these core habitat areas will also protect current and future drinking water supplies, including the North Pond Brook aquifer which supplies drinking water to Orange, the Tully River aquifer which supplies drinking water to Athol, and the high-yield aquifers in Montague and around Kendall Pond in Gardner and Templeton. Much of the land overlying these aquifers and/or contributing recharge to these aquifers is not permanently protected from development. A significant portion of the large, high-yield aquifer that trends in a north/south direction from Winchendon, through Lake Dennison, and into Templeton is already permanently protected. This is the largest high-yield aquifer in the watershed.

Approximately 79% of the Millers River Watershed is covered by forest (1999 MacConnell Land Use Data). As discussed in Chapter 2, this abundance of forested landscape provides a rich variety of habitats for wildlife. However, across the state, the trend in forest type distribution is one of overall forest maturation, with a corresponding loss in early-successional forests such as abandoned fields, grasslands, and shrublands.[82] There are many species of birds that prefer early-successional habitats. With a loss of this type of habitat, the numbers of these species have been declining. Five of six birds commonly associated with grasslands exhibited dramatic declines.[83] Two of these species, the vesper sparrow and grasshopper sparrow, have been identified in the Millers River Watershed. The NHESP has classified these sparrows as threatened in Massachusetts.

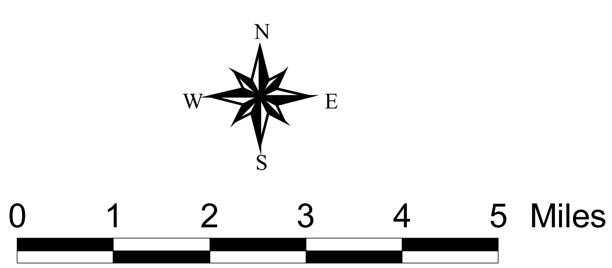
[81] According to the most recent (2003) available data from MassGIS for permanently protected open space.
[82] Upland Habitat Management Program, Massachusetts Division of Fish & Wildlife, web page, www.state.ma.us/DFG/dfw/bdi/uplandintro.htm.
[83] Ibid.

Millers River 5-Year Watershed Action Plan

Permanently Protected Open Space and Biomap Habitat



Sub-basin	Number	Sub-basin	Number
Lower Millers	1	Tarbell Brook	8
Whetstone Brook	2	Priest Brook	9
Lake Rohunta	3	Lawrence Brook	10
Middle Millers River	4	Tully River	11
Otter River	5	West Brook	12
Upper Millers River	6	Gales Brook	13
North Branch Millers	7	Moss Brook	14



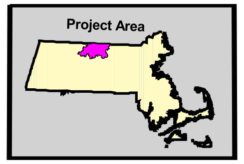
Sub-watershed boundary

Permanently Protected Open Space

NHESP BioMap Core Habitat

Both BioMap Core and Permanently Protected

Town boundary



Map Sources:

Map produced by The Franklin Regional Council of Governments Planning Department. GIS data sources include the FRCOG Planning Department, the Massachusetts Highway Department, MassGIS, Massachusetts Natural Heritage and Endangered Species Program, and United States Fish and Wildlife Service. Digital data obtained from MassGIS represent the efforts of the Massachusetts Executive Office of Environmental Affairs and its agencies to record information from the sources cited in the associated documentation. EOEA maintains an ongoing program to record and correct errors in the GIS data that are brought to its attention. EOEA makes no claims as to the reliability of the GIS data or as to the implied validity of any uses of the GIS data. EOEA maintains records regarding all methods used to collect and process these digital data and will provide this information on request. Executive Office of Environmental Affairs, MassGIS EOEA Data Center, 251 Causeway Street, Suite 900, Boston, MA, 617-626-1000.

Protected open space, NHESP BioMap Core Habitat, watershed, and town boundary data provided by MassGIS.

Note: Depicted boundaries are approximate and are intended for planning purposes only. Portions of the source data were obtained from 1:100,000 scale maps, therefore the accuracy of the line work on this map is +/-100 feet.

FRANKLIN REGIONAL COUNCIL OF GOVERNMENTS
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September 2004

The American Bittern, an endangered marsh bird species in Massachusetts, has been identified in the Millers River Watershed. There may be opportunities for private landowners and land trusts to preserve and restore this critical habitat type in the watershed with assistance from the Massachusetts Department of Fish & Game's Upland Habitat Management Program. www.state.ma.us/DFG/dfw/bdi/uplandintro.htm.

Vernal pool habitat is extremely important to a variety of wildlife species such as amphibians that breed exclusively in vernal pools and other organisms which spend their entire life cycles confined to vernal pool habitat. There are 114 certified vernal pools within the Millers River Watershed. Certified vernal pools are offered protections under the state wetlands protection act regulations, as well as the state water quality certification, state Title 5, and forest cutting practices act regulations. NHESP also identified the locations of over 650 potential vernal pools. Potential vernal pools do not receive protection under state wetlands protection act regulations, or any other state or federal wetlands protection laws. For a vernal pool to be officially certified, specific information must be collected in the field and presented to the NHESP.

Eight (8) of the sixty-five (65) lakes assessed by the MA DEP were infested with non-native aquatic vegetation. Three species were documented: *Myriophyllum heterophyllum* (variable water milfoil), *M. spicatum* (Eurasian water milfoil) and *Cabomba caroliniana* (fanwort). According to the MA DEP, the mere presence of these species is considered to be an imbalance to the native biotic community. In addition, these species have a high potential for spreading and it is likely that they have already established themselves in downstream lakes and reaches of rivers that have not been surveyed by the MA DEP. Two non-native wetland species, *Lythrum salicaria* (purple loostrife) and *Phragmites australis* (reed grass) were identified at three (3) lakes. Although these species do not generally cause impairment of lakes, the invasive growth of these plants can impair surrounding wetland habitat.

Land Use and Growth

Although the majority of the watershed remains forested, rapid, sprawling development (primarily large-lot residential development) has occurred within the watershed and continues to consume watershed resources. Over a twenty-eight year period from 1971 to 1999, a significant change in land uses occurred in the watershed. Forestland, cropland and pastureland categories all lost significant acreage while residential, commercial and industrial land uses gained acreage. During that 28 year timeframe, over 6,670 acres of forest and 889 acres of agricultural land were lost to residential, commercial and industrial development. Residential uses accounted for 5,800 of the developed acres in the watershed. Most of the development that occurred between 1971 and 1999 was concentrated in the eastern portion of the watershed and around the urban areas of Athol and Orange in the western portion of the watershed. This development consumed land in towns that have only a small percentage of their total land area within the Millers River Watershed permanently protected from development (Winchendon, Gardner, Ashburnham, Philipston, Athol and Orange).

Portions of the Millers River Watershed are experiencing significant growth pressure as exhibited by some of the highest growth rates in Massachusetts. Since 1980, the population of watershed communities has increased from 76,118 to 91,986 (according to the 2000 U.S. Census), an increase of 15,868 residents or twenty percent (20%). The growth pressure was greatest in the watershed communities located in Worcester County, with a total of 13,330 new residents locating in these communities (84% of the total growth). By contrast, the towns in Franklin County grew moderately during that time period, due in part to the rural nature of the communities and the very hilly forested terrain in many of them. Watershed communities located in Franklin County increased by a total of 2,538 new residents (16% of the total growth).

The five communities with the greatest population increases (number of new residents) between 1980 and 2000 are Gardner (2,870), Winchendon (2,592), Hubbardston (2,112), Westminster (1,768), and Ashburnham (1,471). These are also the towns in the watershed with the least amount of permanently protected open space and whose resources (drinking water supplies, core habitat areas, potential vernal pools, etc.) are the most vulnerable to development. Towns that grew the least were Petersham, Templeton, Athol, Erving and Warwick. Gardner and Athol possess the two single largest populations, with 20,770 and 11,299 residents respectively – over one-third of the total population (91,986) of the watershed, according to the 2000 U.S. Census.

During the 1980's the region experienced a housing construction boom. A look at residential building permit data for the last decade indicates the pattern and pace of growth in the watershed. Many of these permits were part of a large subdivision of open land. Although the overall growth rate reached its greatest intensity during the 1980s, the watershed communities still grew by 4,704 new residents, a rate of five percent (5%) from 1990 to 2000. Population growth in the region can be mainly attributed to immigration from the Boston metro area during the State's economic boom years. Housing development and in-migration were driven, in large part, by the escalating real estate prices of the greater Boston area. As prices rose, Northern Worcester County became an affordable alternative.

Open Space and Recreation

Many of the key open space issues affecting the Millers River Watershed were discussed in previous sections of this chapter (Wildlife Habitat and Biodiversity, and Land Use and Growth). The Regional Open Space and Recreation Plan for the Millers River Watershed, when finalized, will likely describe additional open space and recreation key issues and priorities. Once the Final Regional Open Space Plan is available, the relevant information should be incorporated into this Watershed Action Plan.

On May 20, 2003, McGregor & Associates facilitated a Public Forum for the Regional Open Space Plan. The following is a list of key issues and priorities which were emphasized during the plenary discussion and the breakout groups.[84]

[84] McGregor & Associates, op.cit.

- Trail networks and greenways need to be identified and additional linkages should be explored and protected. Access to trail networks should be enhanced and standardized signage to inform people about the presence of those trails ought to be developed. Better outreach is needed to explain and advertise the multiple uses of the trails and associated open space.

- Look for ways to increase connections with other nearby resources, such as the Quabbin Reservoir and the North Quabbin Bioreserve.

- A recreation map of the watershed should be prepared for the Millers River and its tributaries.

- Access to the river and its tributaries needs to be enhanced and protected.

- The watershed is more than just the river, its tributaries and protected open space parcels. There are farmlands, wetlands, uplands and other types of open space with various levels of protection that should be incorporated into the plan.

- Create an historic heritage corridor for the Millers in a manner similar to the Blackstone River. This is a good way to meld the open space, historic and cultural resources of the watershed. Economic development of the area ("eco-tourism") can be consistent with the open space protection goals of a regional plan.

- Consider ways in which better consistency in zoning can be encouraged, particularly at town boundaries. In general, zoning bylaws need to be updated in many ways.

- The loss of Chapter 61 parcels to development needs to be addressed. Towns need to understand how such lands can be purchased and how to prioritize potential parcels for purchase when the opportunity arises.

- The Millers River and its tributaries require consistent monitoring for water quality and in general water quality can still be improved.

According to the May 25, 2004 Draft Regional Open Space Plan, the individual Open Space Plans for each of the watershed towns share some common themes. The four goals most commonly expressed were:[85]

- Protect town character and cultural resources;

- Provide recreational opportunities and access;

- Protect water quality; create open space corridors and networks; acquire open space; and increase public awareness; and

[85] McGregor and Associates, op.cit.

- Retain the rural character and protect existing farms.

Public Education/Outreach

The key findings listed below are a compilation of the many issues discussed during the meetings of the Millers River Watershed Advisory Committee.

- Historically and currently, the lack of coordination and communication among town boards, and with neighboring communities, has impeded or prevented effective planning on both a local and watershed scale.

- There is a critical need for improved outreach and education at the local level for municipal officials and appointed board members who implement and enforce land use regulations. Information/training is needed on non-point source pollution, stormwater, smart growth, open space protection, zoning changes, etc.

- Build upon and celebrate the existing partnerships with volunteers, schools and the private sector.

4 – FIVE YEAR WATERSHED ACTION PLAN

Introduction

The purpose of the Five-Year Action Plan for the Millers River Watershed is to set forth the priority issues for the watershed (Goals and Objectives) and to chart a course of action for the watershed stakeholders (Action Items). Successful implementation of the 5-Year Watershed Action Plan will require the participation and collaboration of those people living in the watershed communities, regulators, town boards, committees and staff, the Montachusett Regional Planning Commission, the Franklin Regional Council of Governments, the Millers River Environmental Center, Mt. Grace Land Conservation Trust, Trout Unlimited, the U.S. Army Corps of Engineers, the North Quabbin Regional Landscape Partnership, the Millers River Greenway Corporation, the Millers River Watershed Council, individuals, and many other stakeholders. The dedicated members of the Millers River Watershed Advisory Committee generated a great deal of enthusiasm and momentum during the development of this Watershed Action Plan and demonstrated a commitment to implementing the Plan (see Appendix B for meeting agendas and sign-in sheets). The Letters of Support received for this project (see Appendix C) plus the ongoing commitment of volunteer watershed stewards and advocates indicate that the focused energy and resolve to protect and improve the watershed resources will not be lost.

Accomplishing many of the actions identified in the 5-Year Action Plan will require time and commitment from dedicated volunteers, many of whom are already engaged in projects that are restoring and preserving the resources of the watershed. Where money is required to implement Action Items, it may be sought from grant programs administered by state and federal governmental agencies, private non-profit conservation agencies, foundations, and individual donations in addition to municipal funds. A list of possible funding sources is included in the Appendix A.

The stakeholders involved in this project identified seven overarching goals to achieve their vision of the watershed. The following prioritization of the goals is intended to inform the planning process of state and federal agencies and to help these agencies identify and fund priority projects in the watershed. The priority goals for the Millers River Watershed are listed below:

1. To Support Environmentally Sustainable Growth in the Watershed;
2. To Restore and Improve Natural Flow Regimes and Aquatic Habitat;
3. To Protect and Improve Water Quality in the Watershed;
4. To Preserve and Restore Biodiversity and Wildlife Habitat;
5. To Expand Public Outreach and Educational Activities in the Watershed;
6. To Strengthen Grassroots Support for the Watershed; and

7. To Promote, Protect and Enhance the Open Space and Recreational Value of the Millers River Watershed.

The Millers River Watershed Advisory Committee also developed a list of **Priorities by Year**, which are listed under the Next Steps section of this chapter, to guide the mostly volunteer Watershed Action Plan Implementation Committee over the next 5 years and to inform the grassroots work of local citizen groups, the work plan of the Millers River Environmental Center, the Millers River Team, and other volunteers.

Next Steps

The Millers River Watershed Advisory Committee has prepared an initial prioritization of the Objectives listed in the Action Plan for the 5-year timeframe in order to provide the Implementation Committee and other stakeholders with guidance as they begin work on the Action Plan process. Also, several Action Strategies have been included in this initial prioritization because they are tasks that should be implemented on an ongoing basis. In other words, the structure of the prioritization is fluid and meant to be responsive to changing conditions in the watershed.

Please refer to the 5-Year Action Plan for more details, including specific Action Strategies and lead parties for each objective. The Action Plan contains additional Goals, Objectives and Action Strategies not included in this initial prioritization but which are important nonetheless. Since the Action Plan is organized using a calendar year (January – December), the remaining months of 2004 should be spent on organizational and data collection tasks so that work on the Action Plan items can begin promptly in 2005 (Year 1).

2004 Priorities:

Goal – Prepare to Implement the 5-Year Action Plan

- Collect copies of recently completed EO418 Plans and Open Space Plans for watershed communities and the Regional Open Space Plan for the Millers River Environmental Center Library. *Data collection will be an ongoing task*.

- Establish a permanent Millers River Watershed Advisory Committee to implement the 5-Year Action Plan.

Year 1 Priorities:

Goal – Strengthen Grassroots Support for the Watershed

- Increase the capacity of the Millers River Environmental Center (MREC) to play a proactive role in watershed planning.

- Increase outreach to area legislators to stress the urgency of addressing watershed issues.

- Expand resident involvement in watershed advocacy issues.

Goal – Support Environmentally Sustainable Growth in the Watershed

- Increase the capacity of local officials to proactively manage growth and encourage environmentally sustainable growth.

    - Collaborate with other groups to organize regional educational workshops on sustainable growth topics for local officials, especially Planning Boards and Conservation Commissions. *This should be an ongoing effort.*

Goal – Promote, Protect and Enhance the Open Space and Recreational Value of the Watershed

- Support efforts of watershed towns to implement the recommendations of local Open Space and Recreation Plans, including protecting locally significant open space parcels.

    - Collaborate to sponsor local workshops to educate landowners and voters about Conservation Restrictions, Chapter 61 programs, values of protected land; estate planning that includes land protection, the Community Preservation Act, and other land preservation strategies and tools. *This should be an ongoing effort.*

Goal – Expand Public Outreach and Educational Activities in the Watershed

- Foster a greater sense of watershed stewardship and increase awareness of watershed resources.

    - Sponsor workshops for local officials on watershed-related topics such as non-point pollution, zoning for sustainable growth, and the value of open space protection. *This should be an ongoing effort.*
    - Organize a networking forum for all local environmental groups and interested citizens to facilitate the exchange of resources and contacts. *This should be an ongoing effort.*

Year 2 Priorities:

Goal – Preserve and Restore Biodiversity and Wildlife Habitat

- Work to preserve lands of conservation and wildlife interest at a "watershed-scale".

- Collaborate with the North Quabbin Regional Landscape Partnership (NQRLP) to engage more local interest in joint land protection projects (i.e., Planning Boards, citizen advocacy groups, citizens, Open Space Committees, Conservation Commissions). *This should be an ongoing effort.*
- Support the work of the NQRLP to identify regionally significant open space lands that provide wildlife habitat; regionally significant linkages, funding sources, and the prioritization of lands for acquisition. *This should be an ongoing effort.*

- Protect potential vernal pool locations and other wetland resource areas in the watershed.

Goal – Expand Public Outreach and Educational Activities in the Watershed

- Strengthen and expand the volunteer monitoring network in the watershed.

Year 3 Priorities:

Goal – Restore and Improve Natural Flow Regimes and Aquatic Habitat

- Promote the restoration and enhancement of stream continuity and fish passage along the mainstem and within the tributaries of the Millers River.

Goal – Preserve and Restore Biodiversity and Wildlife Habitat

- Promote the enhancement and creation of wildlife corridors.

Goal – Support Environmentally Sustainable Growth in the Watershed

- Support the implementation of Brownfields and other redevelopment projects that re-use existing structures and direct uses away from undeveloped land ("greenfields").

Year 4 Priorities:

Goal – Protect and Improve Water Quality in the Watershed

- Identify and minimize sources of pollution in the watershed.

    - Facilitate annual joint meetings with neighboring towns' Conservation Commissions and Boards of Health to maintain a cooperative approach to water resource protection and to discuss the potential for collaboration on water quality monitoring and on other non-point source pollution needs. *This should be an ongoing effort.*

Goal – Promote, Protect and Enhance the Open Space & Recreational Value of the Watershed

- Promote, protect and enhance the recreational value of the Millers River and its main tributaries.

- Promote, protect and enhance the trail networks and greenways in the watershed.

Year 5 Priorities:

Goal – Restore and Improve Natural Flow Regimes and Aquatic Habitat

- Manage river flow conditions to more closely resemble natural flow regimes.

- Control the infestation and spread of invasive aquatic plant species within the watershed.

5-Year Action Plan Matrix

The following pages contain the 5-Year Action Plan Matrix for the Millers River Watershed. This Matrix is intended to be a stand-alone document and can be easily copied and distributed to watershed stakeholders who are interested in collaborating to implement projects to improve the watershed's resources.

MILLERS RIVER WATERSHED 5-YEAR ACTION PLAN

Goal: Support Environmentally Sustainable Growth in the Watershed *Objective: Increase the capacity of local officials to proactively manage growth in their communities and encourage environmentally sustainable growth.*		
ACTION STRATEGY	**LEAD PARTIES**	**START DATE**
• Form a Committee to review the findings and recommendations of the EO418 Community Development Plans for watershed towns and the growth management recommendations for watershed communities presented in the Greater Gardner Sustainable Growth Management Plan (December 1999) and the Western Millers River Watershed Growth Management Plan (June 2002). • Conduct follow-up meetings with communities to determine the implementation status of these previous recommendations, discuss obstacles to implementation and success stories, and the recommendations of the recently completed EO418 Community Development Plans, if applicable. • Evaluate community needs and develop strategies to assist with implementation of sustainable growth recommendations.	Millers River Watershed Team, Millers River Watershed Advisory Committee, FRCOG, MRPC, MREC, local Planning Boards, North Quabbin Community Coalition	2005
• Collaborate with other groups to organize regional educational workshops on sustainable growth topics for local officials, especially Planning Boards and Conservation Commissions.	EOEA, FRCOG, MRPC, MREC, local officials, North Quabbin Community Coalition.	2005
• Collaborate to complete a Cost of Community Services (COCS) study for the watershed towns. Encourage discussions among town officials and residents on the costs of services associated with residential development and the value of services provided by open space.	FRCOG, MRPC, Mt. Grace Land Trust, NQRLP, local officials	2005

MILLERS RIVER WATERSHED 5-YEAR ACTION PLAN

Goal: Support Environmentally Sustainable Growth in the Watershed

Objective: Support the implementation of Brownfields and other redevelopment projects that re-use existing structures and direct uses away from undeveloped land ("greenfields")

ACTION STRATEGY	LEAD PARTIES	START DATE
• Collaborate to identify priority sites for redevelopment, in particular, old mill sites adjacent to the river. • Encourage/facilitate a regional (watershed-scale) approach to Brownfields assessment, clean-up and redevelopment (similar to Franklin County).	MRPC, FRCOG, Community Economic Development Committees, developers, MREC, local officials (Boards of Health, Select Boards, etc), North Quabbin Community Coalition.	2007
• Investigate the status of previously funded Brownfields sites and monitor the progress of their clean-up and re-development.	Millers River Watershed Advisory Committee, Town and State officials	2007

MILLERS RIVER WATERSHED 5-YEAR ACTION PLAN

Goal: Restore and Improve Natural Flow Regimes and Aquatic Habitat *Objective: Manage river flow conditions to more closely resemble natural flow regimes*		
ACTION STRATEGY	**LEAD PARTIES**	**START DATE**
• Identify stakeholders and form a working group to revisit the recommendations in the 2003 Hydrologic Assessment for the Millers River prepared by Gomez & Sullivan (such as maintaining run-of-river operations, flushing flows, ramping rates, and seasonal minimum flows below dams). • Prioritize recommendations and collaborate to implement them.	Millers River Watershed Team, Millers River Environmental Center, Millers River Watershed Council, USACE* Trout Unlimited, FRCOG, MRPC, US FWS, MA DFG, MA DCR, MA DEP, Mass Riverways	2009 2009
Objective: Promote the restoration and enhancement of stream continuity and fish passage along the mainstem and within the tributaries of the Millers River		
• Work with the Mass Riverways River Restore Program to complete an inventory of dams within the watershed that no longer serve any useful purpose, and conduct removal feasibility studies at priority sites.	Millers River Watershed Team, Mass Riverways, MRWC, TU, MA DFG	2007
• Assist L.S. Starrett Company in partnering with Mass Riverways River Restore Program and other organizations to investigate the feasibility of constructing downstream fish passage at the Starrett dam.	L.S. Starrett Company, Mass Riverways, Millers River Watershed Team, MREC, TU, MA DFG, MWRC	2007
• Participate in the Mass Riverways River Continuity Partnership to assess river continuity within the watershed and identify mitigation measures for reducing the impacts of existing highway and culvert infrastructure	Millers River Watershed Team, MREC, Stream Teams, local Highway Depts. and Conservation Commissions, MRWC	2007
• Collaborate to design and conserve local and regional "blueways" (river corridors).	Millers River Greenway Corp., MREC, Stream Teams, TU, FRCOG, MRPC	2007

MILLERS RIVER WATERSHED 5-YEAR ACTION PLAN

Goal: Restore and Improve Natural Flow Regimes and Aquatic Habitat *Objective: Control the infestation and spread of invasive aquatic plant species within the watershed*		
ACTION STRATEGY	**LEAD PARTIES**	**START DATE**
• Identify stakeholders and form a study group to gather information on invasive aquatic vegetation and its potential impacts on the watershed. • Implement an education program for boaters. Education materials should be developed to inform boaters about the potential adverse impacts of boats on wildlife and habitat along the river as well as preventing the spread of invasive species by properly cleaning boats. • Pursue funding for control demonstration projects and effectiveness monitoring. • Work with the Public Access Board and other groups to install proper signage and conduct education/outreach efforts.	Millers River Watershed Team, MA DEP, MA DFG, Stream Teams, MREC, local volunteers	2009

MILLERS RIVER WATERSHED 5-YEAR ACTION PLAN

Goal: Protect and Improve Water Quality in the Watershed *Objective: Identify and minimize sources of pollution in the watershed*		
ACTION STRATEGY	**LEAD PARTIES**	**START DATE**
• Seek grant funding for more detailed hydrologic studies of major groundwater aquifers in the watershed to inform land planning, land protection, water quality monitoring, and zoning strategies to conserve groundwater quality.	FRCOG, MRPC, MREC, community water suppliers	2008
• Revisit the recommendations of the 2002 Non-point Source Assessment report and prioritize the action items for implementation.	FRCOG, MRPC, MREC	2008
• Complete TMDL studies for the waterbodies listed as category 5 under the Massachusetts Year 2002 Integrated List of Waters	MA DEP	2006
• Facilitate annual joint meetings with neighboring towns' Conservation Commissions and Boards of Health to maintain a cooperative approach to water resource protection and to discuss the potential for collaboration on water quality monitoring and on other non-point source pollution needs.	Millers River Watershed Team, MREC, FRCOG, MRPC	2008
• Continue SMART monitoring program on the Millers River mainstem and its tributaries.	MA DEP	2004
• Support the reclassification of eligible streams as "Cold Water Fisheries" to provide an additional level of protection for these waters.	MA DFG, TU, Millers River Watershed Team	2006
• Monitor compliance and provide input on NPDES permit renewals within the watershed.	MA DEP, Millers River Watershed Team	2006

MILLERS RIVER WATERSHED 5-YEAR ACTION PLAN

Goal: Protect and Improve Water Quality in the Watershed *Objective: Identify and minimize sources of pollution in the watershed*		
ACTION STRATEGY	**LEAD PARTIES**	**START DATE**
• Establish a Volunteer Monitoring Program and identify projects for volunteers to pursue, such as: o Gathering data to update the 2002 Nonpoint Source Assessment for the watershed o Gathering bacteria, temperature and pH data o Gathering data to help determine potential impacts of road salting practices	MREC, Mass Riverways, local Boards of Health, college interns, high school students, Eagle Scouts	2008
• Identify areas potentially impacted by road salt (wetlands, aquifers, streams) and target sampling efforts in these locations.	Local Boards of Health, MA DEP, Mass Riverways	2008
• Pursue funding to conduct a Landfill Assessment Study of the historic and current landfills in the watershed and their potential impacts on water quality.	Local Boards of Health, MREC, Millers River Watershed Advisory Committee	2008
• Pursue funding to conduct an assessment of existing and historic sand and gravel mining operations in the watershed as recommended in the 2002 Nonpoint Source Assessment for the watershed.	MREC, Millers River Watershed Advisory Committee	2008

MILLERS RIVER WATERSHED 5-YEAR ACTION PLAN

Goal: Preserve & Restore Biodiversity and Wildlife Habitat *Objective: Enhance and restore riparian habitat*		
ACTION STRATEGY	**LEAD PARTIES**	**START DATE**
• Identify stakeholders and convene a partnership group to identify and prioritize areas in need of riparian habitat enhancement and restoration. • Seek funding to implement priority projects.	Mass Riverways, Stream Teams, MREC, FRCOG, MRPC, TU, local Conservation Commissions and Open Space Committees, MRWC	2006
Objective: Work to preserve lands of conservation and wildlife interest at a "watershed-scale"		
• Collaborate with the North Quabbin Regional Landscape Partnership to engage more local interest in joint land protection projects (Planning Boards, citizen advocacy groups, citizens, Open Space Committees, Conservation Commissions) • Support the work of the North Quabbin Regional Landscape Partnership to identify regionally significant open space lands that provide wildlife habitat; regionally significant linkages, funding sources, and the prioritization of lands for acquisition.	Millers River Greenway Corp., North Quabbin Regional Landscape Partnership, MREC, FRCOG, MRPC, local Open Space Committees, Planning Boards, Conservation Commissions, MRWC, MA DCR & MA DFG	2006
Objective: Promote the enhancement and creation of wildlife corridors		
• Collaborate to design and conserve local and regional greenways. • Assess impediments to habitat connectivity (e.g., Rte. 2).	Millers River Greenway Corp., NQRLP, local Open Space Committees and Conservation Commissions, MREC, FRCOG, MRPC, local DPWs, MassHighway	2007

MILLERS RIVER WATERSHED 5-YEAR ACTION PLAN

Goal: Preserve & Restore Biodiversity and Wildlife Habitat *Objective: Promote the enhancement and creation of wildlife corridors*		
ACTION STRATEGY	**LEAD PARTIES**	**START DATE**
• Encourage town Open Space Committees to collaborate with each other and local schools, Boy/Girl Scout groups, and volunteers to implement a program to train volunteers to track/monitor wildlife movement on a landscape/watershed scale. This data would help to inform land conservation planning. • Collaborate with educational outreach groups to install and/or identify and post signage for additional amphibian crossings.	MREC, NQRLP, local Open Space Committees	2007
Objective: Enhance terrestrial habitat biodiversity and promote appropriate forest and land management practices		
• Promote the use of sustainable forest management practices to conserve biodiversity.	MA DCR, MREC, North Quabbin Woods, Conservation Commissions	2008
• Develop a forest management committee, comprised of local foresters and natural resource professionals, to ensure that local conservation commissions have at their disposal appropriate background knowledge, information and resources to complete a thorough review of future forest cutting plans in the watershed.	Millers River Watershed Team, MA DCR, North Quabbin Woods, Town Forest Committees, volunteers	2008
• Collaborate to sponsor annual educational meetings to publicize available forestry management resources.	Mt. Grace Land Trust, Harvard Forest, Service Foresters	2008

MILLERS RIVER WATERSHED 5-YEAR ACTION PLAN

Goal: Preserve & Restore Biodiversity and Wildlife Habitat *Objective: Protect potential vernal pool locations and other wetland resource areas in the watershed.*		
ACTION STRATEGY	**LEAD PARTIES**	**START DATE**
• Protect potential vernal pools locations by utilizing volunteers (i.e., high school students) to complete the NHESP certification process.	MREC, local Conservation Commissions, NHESP, Stream Teams, local volunteers	2006
• Conduct public outreach and education activities with local Conservation Commissions and landowners with respect to the importance of protecting vernal pools and other wetland areas.	MREC, local Conservation Commissions, NHESP, Stream Teams, local volunteers	2006
• Collaborate with towns that have successfully passed and implemented local wetlands bylaws (such as Wendell) to develop strategies for helping watershed towns adopt local wetlands bylaws to provide additional protection to fragile wetland resources (e.g., potential vernal pools).	Local Conservation Commissions, MREC	2006
Objective: Control the infestation and spread of invasive terrestrial plant species		
• Identify stakeholders and form a working group to gather information on invasive terrestrial vegetation and its potential impacts on the watershed. • Pursue funding for control demonstration projects and effectiveness monitoring.	Stream Teams, MREC, local volunteers	2009

MILLERS RIVER WATERSHED 5-YEAR ACTION PLAN

Goal: Expand Public Outreach and Educational Activities in the Watershed *Objective: Foster a greater sense of watershed stewardship and increase awareness of watershed resources*		
ACTION STRATEGY	**LEAD PARTIES**	**START DATE**
• Create additional partnerships with local schools, local officials, watershed residents, local Open Space Committees, and the private sector.	MREC, FRCOG, MRPC, Open Space Committees	2005
• Install signs that identify watershed boundaries and include the names of streams crossed by roads.	MREC, FRCOG, MRPC, Open Space Committees	2005
• Identify opportunities for volunteer involvement in watershed projects; recruit volunteers.	MREC, FRCOG, MRPC, Open Space Committees	2005
• Establish an annual Millers River Watershed Conference.	MREC, Millers River Watershed Council, TU	2005
• Sponsor workshops for local officials on watershed-related topics such as non-point pollution, zoning for sustainable growth, and the value of open space protection.	MREC, FRCOG, MRPC, UMass Extension, EOEA, Open Space Committees	2005
• Develop a place-based Millers River Watershed Education Curriculum for grades K-12 that is consistent with the Massachusetts Education Frameworks	MREC	2007
• Organize a networking forum for all local environmental groups and interested citizens to facilitate the exchange of resources and contacts.	MREC, FRCOG, MRPC, Open Space Committees	2005
• Publicize work of volunteers and other watershed-related work in local newspapers and on local cable TV.	Millers River Advisory Committee	2005

MILLERS RIVER WATERSHED 5-YEAR ACTION PLAN

Goal: Expand Public Outreach and Educational Activities in the Watershed *Objective: Strengthen and expand the volunteer monitoring network in the watershed.*		
ACTION STRATEGY	**LEAD PARTIES**	**START DATE**
• Encourage the development of additional Stream Teams and provide technical support to existing Teams. • Schedule and publicize regular training sessions for volunteers. • Publicize the results of the ongoing volunteer monitoring projects in the watershed (Shoreline Surveys, Mid-Stream Surveys, River Continuity Project; Photo documentation Project) and distribute copies of Stream Team Reports and Action Plans to EOEA, MA DEP, local town boards (Select Board, Conservation Commission, Open Space Committee, Planning Board). Post reports on MREC web site. • Re-evaluate and prioritize projects in the Stream Team Action Plans for the Tully and Otter Rivers that can be implemented by local volunteers and develop a schedule for implementation.	MREC, Riverways Program, Stream Teams, volunteers, local officials	2006

MILLERS RIVER WATERSHED 5-YEAR ACTION PLAN

Goal: Strengthen Grassroots Support for the Watershed *Objective: Expand resident involvement in watershed advocacy activities*		
ACTION STRATEGY	**LEAD PARTIES**	**START DATE**
• Provide timely feedback to Stream Team volunteers and volunteers involved in "hands-on" projects that benefit the watershed. Cultivate long-term relationships with the volunteers by sponsoring pot-luck gatherings and other opportunities for volunteers to come together and share experiences.	MREC, Stream Team leaders, Millers River Watershed Team	2005
• Provide expert guidance to volunteers; increase the knowledge base of the volunteers by inviting experts to train/work with the volunteers.	MREC, Millers River Watershed Team	2005
• Collaborate with local schools to involve/educate the next generation of watershed stewards.	MREC	2005
• Raise awareness of the impact of individual choices on the health of the watershed.	MREC, local Open Space Committees, Millers River Watershed Council	2005
Objective: Increase outreach to area legislators to stress the urgency of addressing watershed issues		
• Develop a contact list of state and federal legislators whose districts include watershed towns. • Develop an "Issue Contact List" or "email alert system" of interested individuals and organizations who agree to lobby for watershed issues and projects. • Advocate for a cleaner river, particularly with respect to PCB contamination.	Millers River Watershed Team, MREC, Millers River Watershed Advisory Committee, local residents	2005

MILLERS RIVER WATERSHED 5-YEAR ACTION PLAN

Goal: Strengthen Grassroots Support for the Watershed *Objective: Increase the capacity of the Millers River Environmental Center to play a proactive role in watershed planning.*		
ACTION STRATEGY	**LEAD PARTIES**	**START DATE**
• Convene a working group to undertake a strategic planning effort for the Millers River Environmental Center (MREC) that would culminate in a Work Plan that presents an administrative framework that includes the establishment of a permanent Millers River Watershed Advisory Committee to oversee the implementation of the 5-Year Watershed Action Plan, prioritizes all projects the Environmental Center is involved with, identifies potential partners and support networks, and potential funding sources.	MREC, Millers River Watershed Team, FRCOG, MRPC	2005
• Pursue funding for projects identified in the MREC Work Plan.	MREC, Millers River Watershed Team, FRCOG, MRPC	2005

MILLERS RIVER WATERSHED 5-YEAR ACTION PLAN

Goal: Promote, Protect and Enhance the Open Space and Recreational Value of the Millers River Watershed *Objective: Promote, protect and enhance the recreational value of the Millers River and its main tributaries.*		
ACTION STRATEGY	**LEAD PARTIES**	**START DATE**
• Investigate the feasibility of additional river access points along the mainstem Millers River, in particular near the historic Toll House in Montague, near Rt. 63 in Millers Falls and other areas identified in this WAP.	MA DCR, TU, MREC, Town of Montague, Public Access Board, Millers River Greenway Corp.	2008
Objective: Promote, protect and enhance the trail networks and greenways in the watershed		
• Identify existing and potential local and regional trail networks and greenways	MREC, FRCOG, MRPC, local trail clubs and Open Space Committees, NQRLP, Millers River Greenway Corp., Equestrian Center in Athol	2008
Objective: Support efforts of watershed towns to implement recommendations of local Open Space & Recreation Plans, including protecting locally significant open space parcels.		
• Collaborate to sponsor local workshops to educate landowners and voters about Conservation Restrictions, Chapter 61 programs, values of protected land, estate planning that includes land protection, the Community Preservation Act, and other land preservation strategies and tools.	Mt. Grace Land Trust, MREC, NQRLP, FRCOG, MRPC, local officials and landowners	2005
• Encourage towns to review municipal land holdings and place conservation restrictions on those properties that are of scenic, historic, cultural, ecological or recreational significance to ensure properties are protected in perpetuity or transfer ownership to local Conservation Commission.	Mt. Grace Land Trust, NQRLP, MREC, FRCOG, MRPC	2005
• Encourage sportsman clubs and other private recreation organizations to place conservation restrictions on their properties to protect them in perpetuity.	Mt. Grace Land Trust, NQRLP, MREC, FRCOG, MRPC	2005

*LIST OF ACRONYMS

USACE = US Army Corps of Engineers
TU = Trout Unlimited
FRCOG = Franklin Regional Council of Governments
MRPC = Montachusett Regional Planning Commission
MA DFG = Mass Department of Fish & Game
MA DCR = Mass Dept. of Conservation & Recreation
MA DEP = Mass Dept. of Environmental Protection
MREC = Millers River Environmental Center
NQRLP = North Quabbin Regional Landscape Partnership
DPW = Dept. of Public Works
MRWC=Millers River Watershed Council

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APPENDIX A
Potential Sources of Funding for Action Plan Projects

POTENTIAL SOURCES OF FUNDING FOR ACTION PLAN PROJECTS

Massachusetts Department of Environmental Protection (MA DEP) -Section 319 Non-point Source Pollution Grants

Contact: Jane Peirce: (508) 767-2792, e-mail: jane.peirce@state.ma.us
Summary: To control non-point sources of water pollution, particularly from urban runoff, paved surfaces, and other areas where rainwater collects pollutants as it runs over the land. **Eligibility:** Any interested public or private organization.
Match: 40% non-federal match of total project cost. In-kind services eligible for match.
$ **Range:** $20,000 to $200,000
Examples: This program funds: sub-watershed and in-lake projects that address all major non-point sources affecting water quality in a waterbody; demonstrations of new or innovative best management practices (BMPs), technologies or institutional approaches to controlling non-point source pollution; groundwater projects that target high priority non-point source groundwater problems; and watershed resource restoration projects that restore vegetated wetlands, lakes, rivers, streams, estuaries, shorelines, riparian areas, seagrass beds and other aquatic habitats.
Schedule: An annual Request for Response (RFR) for project solicitation is issued around March 1, with proposals due to MDEP around May 1.

MA DEP-Massachusetts Clean Water State Revolving Fund Program

Contact: Steven McCurdy (617) 292-5779, e-mail: steven.mccurdy@state.ma.us
Summary: In an effort to provide incentive to communities to undertake projects with meaningful water quality and public health benefits, this program provides financial assistance to help municipalities and wastewater districts to comply with federal and state water quality requirements. The Program provides subsidized, low-interest loans to finance water quality improvement projects, with particular emphasis on watershed management priorities.
Eligibility: Massachusetts municipalities and waste water districts.
Match: None
$ Range: Maximum applicants limited to 15-20% of annual program capacity. Annual capacity is approximately $150 to $200 million dollars.
Examples: Planning and construction of eligible projects, including new wastewater treatment facilities and upgrades of existing facilities; infiltration/inflow correction; wastewater collection systems; control of combined sewer overflows; and non-point source pollution abatement projects, such as landfill capping, community programs for upgrading septic systems (Title 5), and storm water remediation.
Schedule: Solicitation annually during the summer.

MA DEP-Section 604(b) Water Quality Management Planning Grants

Contact: Gary Gonyea: (617) 556-1152, e-mail: gary.gonyea@state.ma.us
Summary: Water quality assessment and management planning.
Eligibility: Regional public comprehensive planning organizations such as: regional planning agencies, councils of government, conservation districts, counties, and cities and towns.
Match: Match not required but proposals are enhanced by demonstration of local support.
$ Range: $30,000 to $60,000
Examples: Provide technical assistance to communities for water supply protection and assist local officials in comprehensive water resource planning.
Schedule: Request for Response is issued by MA DEP each October for competitive projects with proposals due approximately six weeks later. Proposals are evaluated and funding is announced within two months of the proposal submission deadline. Generally, projects are expected to begin approximately eight months after the date of their selection by the MA DEP.

MA DEP-Wetlands and Water Quality Grant Program 104(b)(3)
Contact: Gary Gonyea: (617) 556-1152, e-mail: gary.gonyea@state.ma.us
Summary: This grant program is authorized under Section 104(b)(3) of the federal Clean Water Act. The goal of this program is to fund projects that address MA DEP's water quality and wetland protection goals.
Eligibility: All Massachusetts Environmental Affairs agencies or other organizations with a co-sponsor are eligible. Non-profit organizations such as watershed associations, regional planning agencies, and universities are eligible to submit proposals but only through an EOEA sponsoring agency.
Match: Proposals submitted must identify a 25% non-federal match (25% of Total Project Cost).
Schedule: Request for Response is issued by MDEP each January for competitive projects with proposals due approximately eight weeks later.

MA DEP-Source Water Protection Program
Contact: Kathleen Romero (617) 292-5727, e-mail: kathleen.romero@state.ma.us
Summary: This grant program provides funds to third party technical assistance organizations that assist public water suppliers in protecting local and regional ground and surface water supplies.
Eligibility: 1. Eligible applicants are third party organizations that have experience providing technical assistance related to drinking water protection. 2. Proposed work must benefit active drinking water sources. 3. The third party must submit letter(s) of support from the public water supplier(s) with the application.
Schedule: Request for Response is issued by MDEP each May for competitive projects with proposals due approximately eight weeks later.

Well Head Protection Grant Program
Contact: Catherine Sarafinas (617) 556-1070, e-mail: catherine.sarafinas@state.ma.us
Summary: This grant program provides funds to assist public water suppliers in addressing wellhead protection through local projects and education.
Eligibility: Eligible applicants include all community public water systems, as well as non-transient non-community systems that serve schools. The grant recipient must be a public water system or municipality, and the grant must target an active public water supply source.
Examples: Zone I: Removal or upgrade of potential sources of contamination (for example, underground storage tanks, septic systems, salt storage), wellhead protection signs, and fencing in a pump house. Zone II: Interim wellhead Protection Area (IWPA): Land must be owned and controlled by water supplier or the municipality. Containment and improvement projects (secondary containment of liquid hazardous materials, salt/deicing storage, municipal waste management, drainage improvements and hazardous materials storage). Local town-wide inspection programs for floor drains, underground storage tanks, and hazardous materials.
Schedule: Request for Response is issued by MDEP each May for competitive projects with proposals due approximately eight weeks later.

MA DCR-Lake and Pond Grant Program
Contact: Steve Asen: (617) 626-1353 or steve.asen@state.ma.us
Summary: Lake and Pond protection, preservation, enhancement, and public access.
Eligibility: Municipalities; co-applications are encouraged from Lake and Pond Associations or Districts, and Watershed Associations.
Match: 50% cash match.
$ Range: $1,000-$10,000
Examples: Controlling non-point pollution; eradicating non-native aquatic plant species, developing lake and watershed management plans.
Schedule: In past years, applications were mailed in October and the deadline was December 31. Call for more information.

MA DCR-Recreational Trails Program
Contact: Peter Brandenburg: (617) 626-1453 or peter.brandenburg@state.ma.us
Summary: Construction and improvement of publicly accessible recreational trails.
Eligibility: Municipalities, non-profit groups, and regional and state agencies. **Match:** 20% minimum, in-kind permitted.
$ Range: $2000-$20,000, exceptions considered.
Examples: Trail building materials; support of volunteer trail maintenance activities.
Schedule: Call for more information.

MA DCR-Greenways and Trails Demonstration Grants
Contact: Jennifer Howard: (413) 586-8706 X18; email jennifer.howard@state.ma.us
Summary: Innovative projects that advance the creation and promotion of greenway and trail networks throughout Massachusetts.
Eligibility: Municipalities, regional planning agencies, and non-profit organizations.
Match: None required, although encouraged, including in-kind contributions.
$ **Range:** $1,000 - $5,000; up to $10,000 available for multi-town projects.
Examples: Improving access to rivers and trails, producing greenway and trail brochures, maps, signs, and curricula, and involving community members in greenway and trail planning and implementation.
Schedule: Applications are due in fall/winter each year - call for more information.

MA DCR-Forest Stewardship Program
Contact: Susan Campbell (413) 256-1201 or susan.campbell@state.ma.us
Summary: Grants to private forest landowners to protect forest ecosystems. Landowners, with assistance of MDCR foresters, develop a forest stewardship plan for their property, which makes them eligible for Federal cost sharing funds to help carry out the plan.
Eligibility: Any forest landowner in Massachusetts, who meets the following criteria: ownership must be private, non-industrial, and non-profit; and forest land must be less than 1,000 acres in total size in the State.
Examples: Forest stewardship plans and implementation can include any project which meets one of the 9 main goals, such as wildlife habitat management, erosion reduction, protection of endangered species, trail creation/maintenance, and timber quality improvement.
Schedule: Applications were due in March of past years.

MA DFA-Agriculture Environmental Enhancement Program
Contact: Susan Phinney, Boston (617) 626-1772, e-mail: susan.phinney@state.ma.us
Summary: This program is open to producers and growers who farm 5 acres or more in the state of Massachusetts and have the potential to impact water resources. This program reimburses farmers for the cost of their materials for projects that aim to improve water quality. The farmer is responsible for the cost of installing and maintaining the practice.
Eligibility: Farmers owning farms 5 acres or larger. All applicants must have either an updated USDA Natural Resource Plan or a plan from an approved source such as the one in the "On-Farm Strategies To Protect Water Quality" workbook which can be obtained by calling the Massachusetts Department of Agriculture.
$ Range: The maximum award per project is $20,000. Up to 75% of the cost will be reimbursed prior to the project's completion for projects over $5,000.
Schedule: Annual Request for Response (RFR) is issued in August. Please call for more information.

NRCS-Environmental Quality Incentives Program (EQIP)

The Environmental Quality Incentives Program provides technical, educational, and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers and ranchers in complying with Federal, State, and tribal environmental laws, and encourages environmental enhancement. The program is funded through the Commodity Credit Corporation. The purposes of the program are achieved through the implementation of a conservation plan which includes structural, vegetative, and land management practices on eligible land. Five- to ten year contracts are made with eligible producers. Cost-share payments may be made to implement one or more eligible structural or vegetative practices, such as animal waste management facilities, terraces, filter strips, tree planting, and permanent wildlife habitat. Incentive payments can be made to implement one or more land management practices, such as nutrient management, pest management, and grazing land management. Fifty percent of the funding available for the program will be targeted at natural resource concerns relating to livestock production. The program is carried-out primarily in priority areas that may be watersheds, regions, or multi-state areas, and for significant statewide natural resource concerns that are outside of geographic priority areas. For additional information contact the USDA Natural Resources Conservation Service office serving your county.

NRCS-Wildlife Habitat Incentives Program (WHIP)

The Wildlife Habitat Incentives Program provides financial incentives to develop habitat for fish and wildlife on private lands. Participants agree to implement a wildlife habitat development plan and USDA agrees to provide cost-share assistance for the initial implementation of wildlife habitat development practices. For example, cost-sharing for fish passage structures may be available from the WHIP in addition to habitat improvements such as invasive plant control, streambank stabilization and water cooling. USDA and program participants enter into a cost-share agreement for wildlife habitat development. This agreement generally lasts a minimum of 10 years from the date that the contract is signed. For additional information contact the USDA Natural Resources Conservation Service office serving your county.

Forest Land Enhancement Program (FLEP)

The Forest Land Enhancement Program (FLEP) is part of Title VIII of the 2002 Farm Bill. FLEP replaces the Stewardship Incentives Program (SIP) and the Forestry Incentives Program (FIP). FLEP is optional in each State and is a voluntary program for non-industrial private forest (NIPF) landowners. It provides for technical, educational, and cost-share assistance to promote sustainability of the NIPF forests FLEP is designed to benefit the environment while meeting future demands for wood products. Eligible practices are tree planting, timber stand improvement, site preparation for natural regeneration, and other related activities. Interested landowners can contact any consulting forester or Steve Anderson (Forest Stewardship Program) at 413-256-1201 or steve.anderson@state.ma.us.

Mass Riverways-Urban Rivers Small Grants

Contact: Joan Kimball: (617) 626-1544 or joan.kimball@state.ma.us
Summary: For projects that seek to restore urban rivers.
Eligibility: Municipalities and non-profit groups located in urbanized areas.
Match: No match requirement.
$ Range: $3,000 - $8,000
Examples: First year grants.
Schedule: Call for more information.

Massachusetts Environmental Trust Environmental Grants

Contact: Robbin Peach: (617) 727-0249
Summary: The Trust funds projects that: (1) encourage cooperative efforts to raise environmental awareness, and (2) support innovative approaches that can protect and preserve our natural resources, with a special focus on water and related land resources.
Eligibility: Non-profit, community associations, civic groups, schools and institutions for higher education, municipalities, and state agencies.
Match: See individual program guidelines.
$ Range: See individual program guidelines.

Examples: Recipients have included the Coalition for Buzzards Bay, Springfield Science Museum, Pioneer Valley Planning Commission, Association for the Preservation of Cape Cod, and many others.
Schedule: Annual Request for Response is available on October and Letters of Inquiry are due in December. All program guidelines are available on the Trust's web site. http://www.agmconnect.org/maenvtr1.html.

MHFA-Homeowner Septic Repair Loan Program
Contact: (617) 854-1020 or (617) 854-1333
Summary: Through a combined effort of the Department of Environmental Protection, the Massachusetts Department of Revenue, and the Massachusetts Housing Finance Agency, this program provides below market rates to homeowners upgrading septic systems.
Eligibility: Homeowner septic repair loans are available to eligible homeowners at low interest rates of 0%, 3%, and 5%, depending on income.
$ Range: Homeowner loans range in size from $1,000 to a maximum of $25,000.
Schedule: Call for more information.

APPENDIX B
Letters of Support

Commonwealth of Massachusetts

Riverways Programs

An Agency of the Department of Fish and Game
David M. Peters, *Commissioner*

Joan C. Kimball, *Riverways Director*
251 Causeway • Suite 400 • Boston, MA 02114
(617) 626-1544

27 August, 2004

Vandana Rao
Assistant Director for Water Policy
EOEA
100 Cambridge Street, Suite 900
Boston, MA 02114

Dear Vandana,

I was fortunate to be involved with and benefit from participating on many of the Massachusetts Watershed Initiative teams. Through this association I broaden my knowledge of the watersheds. The cooperative efforts to develop projects, layout work plans, and achieve improvements provided me, as a partner, with insight into each watershed- its needs, 'personality' and advocates. The Millers River watershed stood out as a particularly successful example of how the MWI could create a solid foundation of sound management and protection methods.

The success of the MWI in the Millers River has a worthy culmination in the recently completed five year watershed action plan. The Franklin Regional Council of Governments established an open and welcoming process. The tradition of inclusiveness by the Millers River Team was maintained admirably in the many public outreach meetings held to gather input for the WAP, the availability of drafts and support documents for review and the creation of an Advisory Committee. FRCOG's effectiveness in bringing all partners to the table was evident in the broad participation of the towns and the citizens of the watershed. This level of involvement is evident in the action plan produced.

The Millers River watershed will benefit from the thoroughness and quality of the FRCOG action plan. The river has many concerned and active stewards who will be able to use the recommendations and supporting material in the WAP to advance projects and protections in the watershed. I do not doubt the action plan will be well used over the coming years and not become a document sitting on a shelf.

It was a pleasure to participate in this undertaking. Kimberly Knoake MacPhee deserves special commendation for her talents at facilitation, consensus building, and insight. Her concern for the watershed, the quality and usability of the product is evident. I look forward to working in the Millers River watershed to implement the recommendations of the WAP.

Kind regards,

Cindy Delpapa
Riverways Program

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO
ATTENTION OF

August 20, 2004

U.S. Army Corps of Engineers
Tully Lake Park Office
2 Athol-Richmond Road
Royalston, MA 01368

Vandana Rao, Ph.D.
Asst. Director for Water Policy
Executive Office of Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Dear Dr. Rao:

I am writing to let you know of my support for the Millers River Watershed Action Plan recently submitted for your review. I participated on the Millers River Watershed Advisory Committee under the able leadership of Kimberly Noake MacPhee, P.G., Natural Resources Program Manager for the Franklin Regional Council of Governments.

The Committee brought together a variety of perspectives from Watershed stakeholders, allowing citizens, non-government organizations, town officials, and state and federal agencies to voice their opinions in an open forum. The Action Plan incorporates these voices and provides an excellent guideline for priority actions to restore and protect the Watershed for the benefit of public health and safety and recreation, ecosystem biodiversity, and economic sustainability, now and for generations to come.

I encourage the state to fund the recommended priority actions, making the plan a working reality.

Sincerely,

Jeffrey C. Mangum
Park Manager

Copy Furnished:
Kimberly Noake MacPhee

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Division of Watershed Management, 627 Main Street, Worcester, MA 01608

MITT ROMNEY
Governor

KERRY HEALEY
Lieutenant Governor

ELLEN ROY HERZFELDER
Secretary

ROBERT W. GOLLEDGE, Jr.
Commissioner

August 20, 2004

Vandana Rao, Ph.D.
Assistant Director for Water Policy
Executive Office of Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Dear Ms. Rao:

As the former Executive Office of Environmental Affairs Team Leader for the Millers River Watershed, I would like to commend the Millers River Advisory Committee, the Franklin Regional Council of Governments and the Millers River Environmental Center on their excellent work in putting together the Millers River Watershed 5-Year Action Plan.

The report presents a comprehensive summary of existing information and clearly identifies the current environmental issues in the watershed. The stated action plan goals, objectives and priorities are right on target with the issues in the watershed. By having strategies, lead parties and start dates clearly identified, the Millers River Watershed is in a good position to begin implementation activities and achieve its stated goals and objectives. This Water Action Plan will serve as a road map for communicating, guiding and implementing specific actions to achieve environmental results in the watershed.

Overall this is an excellent action plan and as the DEP Basin Planner for the Millers River watershed, I look forward to working on water quality issues in this watershed.

Sincerely,

Alice M. Rojko
Environmental Analyst

CONNECTICUT RIVER WATERSHED COUNCIL
Protecting the Connecticut River Since 1952
15 Bank Row, Greenfield, MA 01301

August 20, 2004

Vandana Rao, Ph.D.
Assistant Director for Water Policy
Executive Office of Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Dear Vandana,

I am writing in support of the *Millers River 5-Year Watershed Action Plan* prepared by the Franklin Regional Council of Governments (FRCOG), the Millers River Watershed Advisory Committee, and the Millers River Environmental Center. CRWC participated in two of the public meetings for the Action Plan, and we were impressed by the quality of FRCOG's presentations as well as their effort to involve the public as much as possible.

As you know, CRWC is a non-profit environmental advocate for the protection, restoration, and sustainable use of the four-state Connecticut River watershed. The Millers River Watershed Council and Millers River Environmental Center are doing wonderful work in this subwatershed, and we invite collaboration with them whenever possible.

As the committee works towards implementing the Action Items outlined in Section 5 of this report, CRWC would like to mention that we have a habitat restoration program which may be of some assistance in meeting the first goal, to restore and improve natural flow regimes and aquatic habitat. CRWC sometimes has grant money to install fish ladders or remove dams, and we have been the "clerk of the works" for several projects. We look forward to the possibility of working with the Millers River Watershed Team on habitat restoration and other issues.

Sincerely,

Andrea F. Donlon

Andrea F. Donlon
River Steward

HEADQUARTERS: (413) 772-2020
FAX: (413) 772-2090
UPPER VALLEY: (802) 869-2792
E-MAIL: crwc@crocker.com
LOWER VALLEY: (860) 704-0057
WEB: www.ctriver.org

TOWN OF NEW SALEM
MASSACHUSETTS
01355

Kimberly Noake MacPhee, P.G.
Natural Resources Program Manager
Franklin Regional Council of Governments
425 Main Street
Greenfield, MA 01301

August 30, 2004

Dear Ms. MacPhee,

The Select board and Planning Board members of New Salem thank you and your committee for the excellent action plan developed to protect the water resources of the Millers River Watershed.

The northeast part of our town lies within the Millers and the rest flows into the Quabbin Reservoir so we are aware of the importance of such planning and resulting community actions.

Many specific elements from the Action Plan will assist us as we develop our town's resources and strategies for their protection.

Thank you again for your efforts.

Sincerely,

B Sz Vz
SELECTBOARD - CHAIR
Jean Marie Dendrinos, Acting Chair, New Salem Planning Bd.

Kimberly Noake MacPhee

From: Bonnie House [bonbon@net1plus.com]
Sent: Friday, August 20, 2004 11:04 AM
To: natres@frcog.org
Subject: letter

20 August 2004

Vandana Rao, Ph.D.
Assistant Director for Water Policy
Executive Office for Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Dear Dr. Rao:
While I was serving the Town of Phillipston as a member of the Conservation Commission I supported the efforts of Kimberly MacPhee and the Franklin Regional Council of Governments in their development of a Regional Open Space Plan. It is vital for each community to align itself with the greater picture so that we can better plan for the future protection and use of our natural resources. As urban sprawl encroaches and towns in western Massachusetts turn into bedroom communities for major cities, we must work together to develop green corridors that will protect our dwindling wetlands, flora and fauna. The forethought of Ms. MacPhee and the Franklin Regional Council of Governments in bringing together representatives of our various towns to develop goals for our greater good needs encouragement and support.

Sincerely yours,

Bonnie House
110 Blake Corner Road
Phillipston, MA 01331

31 Columbian Ave.
Athol, MA 01331
August 20, 2004

Vandana Rao, Ph.D.
Asst. Director for Water Policy
Executive Office of Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Dear Ms. Rao,

I am writing in support of the Millers River Watershed Action Plan. As a member of the Advisory Committee, it was my pleasure to serve with a group of dedicated citizens having the common goal of improving the condition of the watershed. The many issues of environmental concern that were addressed all need attention. However, the committee was extremely astute in assigning priorities to the problems under consideration. Implementation of the Action Strategies will greatly enhance the health and physical conditions of the watershed.

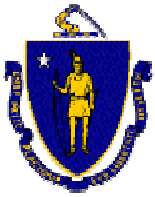
The Millers River Greenway Corp., which I represent, is primarily interested in the development of a "Greenway" and a water corridor between the towns of Athol and Orange. This effort includes improving recreational activities in the region. We are also interested in the biological diversity and wildlife habitat of the watershed.

Implementation of the Watershed Action Plan will greatly benefit the health of the watershed and the residents of the region.

Sincerely,

/s/ Walter H. Davidson

Walter H. Davidson, USDA Research Forester (retired)
President, Millers River Greenway Corp.



Mitt Romney
Governor

Kerry Healey
Lt. Governor

Ellen Roy Herzfelder
Secretary

Executive Office of Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

(617) 626-1000
http://www.mass.gov/envir/